THE NEWS LETTER
OF THE
BUREAU OF PUBLIC ROADS

VOL. 2, NO. 7 MAY, 1927 A. C. ROSE, EDITOR

CONTENTS

MEMORANDUM FROM CHIEF OF BUREAU CONCERNING JUNIOR CIVIL ENGINEERS

TRANSMITTED TO DIVISION CHIEFS AND DISTRICT ENGINEERS
ON APRIL 20, 1927

FOR SOME TIME MR. ALLEN AND I HAVE HAD UNDER CONSIDERATION THE QUESTION OF IMPROVING THE STANDARD OF ENGINEERING PERSONNEL IN THE BUREAU THROUGH THE DEVELOPMENT AND TRAINING OF YOUNG MEN TO FIT THEM FOR THE HIGHER POSITIONS. THIS I CONSIDER ONE OF THE MOST IMPORTANT PROBLEMS WITH WHICH THE BUREAU IS CONFRONTED. TO RETAIN THE LEADERSHIP WHICH THE BUREAU HAS GAINED IN HIGHWAY MATTERS, IT IS NECESSARY TO BUILD FROM THE BOTTOM AND TO DEVELOP AND MAINTAIN A THOROUGHLY TRAINED AND EXPERIENCED ENGINEERING PERSONNEL.

MR. ALLEN, THROUGH THE CONSTRUCTION COST STUDIES WHICH HE HAS SUPERVISED DURING THE PAST FEW YEARS, AND THROUGH THE CONTACT WHICH HE HAS HAD WITH THE PRINCIPAL ENGINEERING SCHOOLS OF THE COUNTRY, HAS MADE A CONSIDERABLE START IN ACCOMPLISHING THIS PURPOSE. THE COST STUDIES HAVE AFFORDED THE BEST OPPORTUNITY OF GIVING THE YOUNG ENGINEERS VARIED CONSTRUCTION EXPERIENCE, AND A NUMBER OF THE YOUNG MEN WHO HAVE RECEIVED EXPERIENCE ON THESE STUDIES HAVE BEEN PLACED IN THE VARIOUS DISTRICTS IN THE HIGHER POSITIONS. LAST YEAR MR. ALLEN VISITED A NUMBER OF THE LEADING TECHNICAL INSTITUTIONS IN VARIOUS PARTS OF THE COUNTRY, AND SELECTED PROMISING YOUNG MEN IN THEIR JUNIOR YEAR FOR TEMPORARY APPOINTMENT DURING THEIR SUMMER VACATION. THEY WERE ASSIGNED TO COST-STUDY PROJECTS AND THEIR WORK CAREFULLY WATCHED. THEY WERE URGED TO TAKE THE JUNIOR CIVIL ENGINEER EXAMINATION HELD BY THE CIVIL SERVICE COMMISSION DURING THE PAST WINTER TO ESTABLISH THEIR ELIGIBILITY FOR PROBATIONAL APPOINTMENT UPON GRADUATION. THIS PROCEDURE IS BEING REPEATED THIS YEAR AND EXCELLENT COOPERATION IS BEING GIVEN BY THE ENGINEERING SCHOOLS.

BECAUSE OF THE IMPORTANCE OF THIS PHASE OF OUR WORK, AND THE NECESSITY FOR COORDINATING OUR EFFORTS ALONG THESE LINES, IT IS BEING MADE A MAJOR FUNCTION OF THE DIVISION OF CONTROL. MR. ALLEN WILL HAVE RESPONSIBILITY FOR AND CONTROL OF THE TRAINING OF ALL JUNIOR ENGINEERS IN THE ORGANIZATION. HE WILL RECOMMEND TO THE CHIEF OF BUREAU THE SELECTION, ASSIGNMENT AND TRANSFER OF ALL JUNIOR ENGINEERS WITH A VIEW TO DEVELOPING THEM INTO THOROUGHLY TRAINED AND QUALIFIED HIGHWAY ENGINEERS, AND WILL SUPERVISE THEIR WORK. THEY WILL BE GIVEN AS VARIED EXPERIENCE IN THE HIGHWAY FIELD AS POSSIBLE, AND WILL BE SHIFTED AMONG THE DISTRICTS AND DIVISIONS. IT IS REQUESTED THAT DISTRICT ENGINEERS AND DIVISION CHIEFS COOPERATE FULLY WITH MR. ALLEN. REQUESTS FOR APPOINTMENT OF JUNIOR ENGINEERS SHOULD SPECIFY THE KIND OF MAN DESIRED AND THE EXACT NATURE OF WORK TO BE DONE. THE JUNIOR ENGINEERING PERSONNEL OF THE BUREAU WILL BE CONSIDERED AS A WHOLE, SO FAR AS ASSIGNMENT AND PROMOTION ARE CONCERNED.

It should be understood that this does not disturb the routine of organization or discipline but represents a superimposed course of training upon the men who come into this organization to fit them for the organization, and the results will depend largely upon the cooperation of the executives and older engineers in the Bureau.

PRESENT STATUS OF UNITED STATES ROUTES 11, 20, 30 AND 31

Contributed by F. W. Mills of the Division of Design

United States route 11 is 98 per cent improved with sand-clay, gravel or macadam surfacing or high-type pavement. The 2 per cent now unimproved will be completed during 1927. There is continuous gravel, or bituminous surfacing or pavement from the Canadian boundary at Rouses Point to the Georgia line near Chattanooga - a distance of 1,214 miles - and from Gadsden to Bessemer, Ala. Between this point and the terminus of the route at New Orleans there are 70 miles of graded or unimproved road out of a total of 507 miles. The balance is either gravel or its equivalent or high-type pavement. The total length of the route from the Canadian line to New Orleans is 1,721 miles.

A detailed statement of the condition of the road as determined by the Bureau survey follows:

UNITED STATES ROUTE 11

State	City or town	Type	Miles	Total
New York	Canadian border at			
	Rouses Point			
	via Malone	Concrete and		
	Canton	bituminous		
	Watertown	macadam	294.65	
	Cortland	City pavement	29.22	323.87
	Binghamton			
	to Pennsylvania			
	State line			
Pennsylvania	New York State line			
	via Milford	Concrete and		
	Scranton	bituminous		
	Sunbury	macadam	225.32	
	Harrisburg	City pavement	26.06	251.38
	Chambersburg			
	to Maryland State line			
Maryland	Pennsylvania State line			
	via Hagerstown	Concrete and		
	Williamsport	bituminous		
	to Virginia State line	macadam	13.00	13.00

UNITED STATES ROUTE 11 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
WEST VIRGINIA	MARYLAND STATE LINE	WATERBOUND AND		
	VIA MARTINSBURG	SURFACE-TREATED		
	TO VIRGINIA STATE LINE	MACADAM	26.00	26.00
VIRGINIA	WEST VIRGINIA STATE LINE			
	VIA WINCHESTER			
	HARRISONBURG			
	STAUNTON	BITUMINOUS AND		
	LEXINGTON	SURFACE-TREATED		
	ROANOKE	MACADAM	355.00	355.00
	WYTHEVILLE			
	TO BRISTOL AT THE			
	TENNESSEE STATE LINE			
TENNESSEE	VIRGINIA STATE LINE AT	CONCRETE AND		
	BRISTOL	BITUMINOUS		
	VIA RUTLEDGE	MACADAM	134.3	
	KNOXVILLE	WATERBOUND		
	ATHENS	MACADAM	26.2	
	CHATTANOOGA	GRAVEL AND SUR-		
	TO GEORGIA STATE LINE	FACE-TREATED		
		GRAVEL	85.8	246.3
GEORGIA	TENNESSEE STATE LINE			
	VIA FENTON	GRAVEL	24.00	24.00
	TO ALABAMA STATE LINE			
ALABAMA	GEORGIA STATE LINE			
	VIA FORT PAYNE			
	GADSDEN	CONCRETE	55.77	
	ASHVILLE	GRAVEL AND		
	BIRMINGHAM	CHERT	140.44	
	TUSCALOOSA	GRADED EARTH	39.22	
	LIVINGSTON	UNIMPROVED	27.00	262.43
	TO MISSISSIPPI STATE			
	LINE NEAR CUBA			
MISSISSIPPI	ALABAMA STATE LINE			
	VIA MERIDIAN			
	LAUREL	CONCRETE	19.04	
	HATTIESBURG	GRAVEL	152.71	
	POPLARVILLE	GRADED AND		
	TO LOUISIANA STATE	DRAINED	3.72	175.47
	LINE			

UNITED STATES ROUTE 11 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
LOUISIANA	MISSISSIPPI STATE LINE			
	VIA SLIDELL			
	TO NEW ORLEANS	GRAVEL	43.99	43.99
			TOTAL MILES	1,721.44

SUMMARY OF TYPES
UNITED STATES ROUTE 11

	MILES	PER CENT
CONCRETE AND BITUMINOUS MACADAM	1,097.08	63.7
CITY PAVEMENT	55.28	3.2
WATERBOUND AND SURFACE-TREATED MACADAM	52.20	3.0
GRAVEL, PLAIN AND SURFACE TREATED	446.94	26.0
EARTH AND GRADED AND DRAINED ROADS	42.94	2.5
UNIMPROVED	27.00	1.6
	1,721.44	100.0

UNITED STATES ROUTE 20 IS 72 PER CENT IMPROVED WITH LOW OR HIGH-TYPE SURFACING. THE OTHER 28 PER CENT CONSISTS OF GRADED AND DRAINED OR UNIMPROVED ROAD. THIS ROAD BEGINS AT BOSTON AND EXTENDS ACROSS THE NORTHERN TIER OF STATES TO ITS TERMINATION AT YELLOWSTONE NATIONAL PARK. IN THE SENSE OF CROSSING THE COUNTRY FROM COAST TO COAST, IT IS NOT A TRANSCONTINENTAL ROUTE. THE TOTAL LENGTH IS 2,542 MILES.

A DETAILED STATEMENT OF THE CONDITION OF THE ROAD AS DETERMINED BY THE BUREAU SURVEY FOLLOWS:

UNITED STATES ROUTE 20

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
MASSACHUSETTS	FROM BOSTON			
	VIA WORCESTER	REINFORCED CON-		
	SPRINGFIELD	CRETE, CONCRETE		
	PITTSFIELD	AND BITUMINOUS		
	TO NEW YORK STATE LINE	MACADAM	165.04	165.04
NEW YORK	FROM MASSACHUSETTS STATE	BITUMINOUS CON-		
	LINE	CRETE AND BITU-		
	VIA ALBANY	MINOUS MACADAM	398.12	
	CHERRY VALLEY	UNIMPROVED	39.01	437.13
	AUBURN			
	CANANDAIGUA			
	WARSAW			
	FREDONIA			
	TO PENNSYLVANIA STATE			
	LINE			

UNITED STATES ROUTE 20 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
PENNSYLVANIA	FROM NEW YORK STATE LINE	REINFORCED CON-		
	VIA ERIE	CRETE AND BITU-		
	NORTH GIRARD	MINOUS MACADAM	46.03	46.03
	TO OHIO STATE LINE			
OHIO	FROM PENNSYLVANIA STATE	BRICK, REIN-		
	LINE	FORCED CONCRETE,		
	VIA ASHTABULA	CONCRETE AND		
	PAINESVILLE	BITUMINOUS		
	CLEVELAND	MACADAM	257.40	257.40
	ELYRIA			
	OBERLIN			
	MONROEVILLE			
	FREMONT			
	PERRYSBURG			
	FAYETTE			
	TO INDIANA STATE LINE			
INDIANA	FROM OHIO STATE LINE			
	VIA ANGOLA			
	ELKHART			
	SOUTH BEND			
	LA PORTE	CONCRETE	159.20	159.20
	MICHIGAN CITY			
	TO ILLINOIS STATE LINE			
ILLINOIS	FROM INDIANA STATE LINE			
	AT HAMMOND			
	VIA ELGIN			
	MARENGO			
	ROCKFORD	CONCRETE	180.40	180.40
	FREEPORT			
	WOODBINE			
	GALENA			
	TO IOWA STATE LINE			
	AT EAST DUBUQUE			
IOWA	FROM ILLINOIS STATE LINE			
	AT DUBUQUE			
	VIA MANCHESTER			
	INDEPENDENCE			
	WATERLOO	CONCRETE	106.58	
	IOWA FALLS	GRAVEL	213.62	
	WEBSTER CITY	GRADED AND	18.33	338.53
	FORT DODGE	DRAINED		
	ROCKWELL CITY			
	SAC CITY			
	TO NEBRASKA STATE LINE			
	AT SIOUX CITY			

UNITED STATES ROUTE 20 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
NEBRASKA	FROM IOWA STATE LINE			
	AT SIOUX CITY			
	VIA RANDOLPH			
	ORCHARD	CONCRETE	2.00	
	O'NEILL	GRAVEL	103.18	
	AINSWORTH	SAND-CLAY	35.62	
	VALENTINE	EARTH	307.18	
	GORDON	UNIMPROVED	46.81	494.79
	CHADRON			
	HARRISON			
	TO WYOMING STATE LINE			
WYOMING	FROM NEBRASKA STATE LINE			
	VIA LUSK	CONCRETE AND		
	ORIN	BITUMINOUS		
	DOUGLAS	MACADAM	9.00	
	CASPAR	GRAVEL	49.30	
	SHOSHONI	SELECTED MATERIAL		
	WORLAND	OR TOP SOIL	76.30	
	GREYBULL	GRADED AND		
	CODY	DRAINED	174.70	
	TO YELLOWSTONE NATIONAL	UNIMPROVED	154.10	
	PARK BOUNDARY			463.40
		TOTAL MILES		2,541.92

SUMMARY OF TYPES
UNITED STATES ROUTE 20

	MILES	PER CENT
BRICK, CONCRETE AND BITUMINOUS MACADAM	1,323.77	52.1
GRAVEL	366.10	14.4
SELECTED MATERIAL OR TOP SOIL	76.30	3.0
SAND-CLAY	35.62	1.4
EARTH AND GRADED AND DRAINED ROADS	500.21	19.7
UNIMPROVED	239.92	9.4
	2,541.92	100.0

UNITED STATES ROUTE 30 IS CONTINUOUSLY IMPROVED WITH BITUMINOUS MACADAM, OR THE HIGHER TYPES OF SURFACING FROM ATLANTIC CITY, N. J., TO WHEATLAND, IA., AND FROM BORDER, WYO., TO PORTLAND, ORE. OF THE TOTAL LENGTH OF 3,347 MILES, 81 PER CENT IS SURFACED WITH SELECTED MATERIAL, GRAVEL OR HIGHER TYPES OF SURFACING. ROUTE 30 COINCIDES WITH THE LINCOLN HIGHWAY BETWEEN PHILADELPHIA AND GRANGER, WYO. IN NEBRASKA, IDAHO AND OREGON THE LINE FOLLOWS CLOSELY THE OLD OREGON TRAIL AS NEARLY AS THE TRAIL MAY NOW BE IDENTIFIED.

A DETAILED STATEMENT OF THE CONDITION OF THE ROAD AS DETERMINED BY THE BUREAU SURVEY FOLLOWS:

UNITED STATES ROUTE 30

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
NEW JERSEY	FROM ATLANTIC CITY	BRICK, CONCRETE		
	VIA EGG HARBOR	AND BITUMINOUS		
	TO CAMDEN	MACADAM	61.00	61.00
PENNSYLVANIA	FROM PHILADELPHIA			
	VIA LANCASTER			
	GETTYSBURG	BRICK, CONCRETE		
	MCCONNELLSBURG	AND BITUMINOUS		
	GREENSBURG	MACADAM	320.60	
	PITTSBURGH	EARTH	9.40	330.00
	TO PENNSYLVANIA STATE LINE			
WEST VIRGINIA	FROM PENNSYLVANIA STATE LINE TO OHIO STATE LINE	CONCRETE	4.00	4.00
OHIO	FROM WEST VIRGINIA STATE LINE			
	VIA LISBON	BRICK ON CONCRETE, CONCRETE, BITUMINOUS CONCRETE OR MACADAM		
	CANTON			
	WOOSTER			
	MANSFIELD			
	MARION		218.48	
	LIMA	SURFACE-TREATED WATERBOUND MACADAM		
	VAN WERT			
	TO INDIANA STATE LINE		32.52	251.00
INDIANA	FROM OHIO STATE LINE			
	VIA FORT WAYNE			
	COLUMBIA CITY	REINFORCED CONCRETE AND CONCRETE		
	WARSAW			
	VALPARAISO		173.00	173.00
	TO ILLINOIS STATE LINE WEST OF DYER			
ILLINOIS	FROM INDIANA STATE LINE			
	VIA CHICAGO HEIGHTS			
	AURORA			
	JOLIET			
	GENEVA			
	DIXON	CONCRETE	174.00	174.00
	MORRISON			
	FULTON			
	TO MISSISSIPPI RIVER AND ILLINOIS STATE LINE			

UNITED STATES ROUTE 30 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
IOWA	FROM ILLINOIS STATE LINE			
	VIA CLINTON			
	DEWITT			
	CEDAR RAPIDS			
	BELLE PLAINE			
	TAMA	CONCRETE	201.12	
	MARSHALLTOWN	GRAVEL	91.32	
	AMES	GRADED AND DRAINED	58.62	
	SCRANTON	EARTH	30.20	381.26
	DENISON			
	DUNLAP			
	MISSOURI VALLEY			
	COUNCIL BLUFFS			
	TO NEBRASKA STATE LINE			
NEBRASKA	FROM IOWA STATE LINE			
	AT OMAHA			
	VIA FREMONT			
	COLUMBUS			
	CENTRAL CITY	BRICK OR CONCRETE	50.57	
	GRAND ISLAND	GRAVEL	269.56	
	NORTH PLATTE	EARTH	166.11	
	BIG SPRING	UNIMPROVED	21.00	507.24
	SIDNEY			
	KIMBALL			
	TO WYOMING STATE LINE			
WYOMING	FROM NEBRASKA STATE LINE			
	VIA CHEYENNE			
	LARAMIE			
	MEDICINE BOW			
	PARCO			
	RAWLINS	GRAVEL	26.6	
	ROCK SPRINGS	SELECTED MATERIAL	188.8	
	GREEN RIVER	GRADED AND DRAINED	262.6	
	GRANGER	UNIMPROVED	8.9	486.9
	KEMMERER			
	SAGE			
	COKEVILLE			
	TO IDAHO STATE LINE			

UNITED STATES ROUTE 30 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
IDAHO	FROM WYOMING STATE LINE			
	VIA MONTPELIER			
	SODA SPRINGS	CONCRETE AND BITU-		
	POCATELLO	MINOUS CONCRETE	28.78	
	AMERICAN FALLS	GRAVEL	311.12	
	TWIN FALLS	SAND-CLAY	45.64	
	BOISE	GRADED AND DRAINED	34.30	
	FRUITLAND	UNIMPROVED	30.90	450.74
	TO OREGON STATE LINE			
	AT ONTARIO			
OREGON	FROM IDAHO STATE LINE			
	VIA BAKER			
	LA GRANDE	CONCRETE AND BITU-		
	PENDLETON	MINOUS CONCRETE	207.08	
	HEPPNER JUNCTION	MACADAM	127.36	
	THE DALLES	GRAVEL	193.77	528.21
	PORTLAND			
	TO ASTORIA			
		TOTAL MILES		3,347.35

SUMMARY OF TYPES
UNITED STATES ROUTE 30

	MILES	PER CENT
BRICK, REINFORCED AND PLAIN CONCRETE, BITUMINOUS CONCRETE OR MACADAM AND SURFACE-TREATED MACADAM	1,471.15	43.9
GRAVEL, WATERBOUND MACADAM, SAND-CLAY AND SELECTED MATERIAL	1,254.17	37.5
EARTH AND GRADED AND DRAINED ROADS . . .	561.23	16.8
UNIMPROVED	60.80	1.8
TOTAL	3,347.35	100.0

UNITED STATES ROUTE 31 IS IMPROVED WITH PLAIN AND REINFORCED CONCRETE, BITUMINOUS MACADAM, ROCK ASPHALT, MACADAM AND GRAVEL FOR 77 PER CENT OF ITS ENTIRE LENGTH OF 1,385 MILES. THE ROUTE EXTENDS FROM MACKINAW CITY, MICH., THROUGH INDIANA, KENTUCKY AND TENNESSEE TO MOBILE, ALA.

A DETAILED STATEMENT OF THE CONDITION OF THE ROAD AS DETERMINED BY THE BUREAU SURVEY FOLLOWS:

UNITED STATES ROUTE 31

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
MICHIGAN	FROM MACKINAW CITY, MICH.			
	VIA PETOSKEY			
	TRAVERSE CITY	CONCRETE	190.01	
	MANISTEE	MACADAM	57.60	
	LUDINGTON	GRAVEL	85.38	
	MUSKEGON	UNIMPROVED	60.63	393.62
	GRAND HAVEN			
	HOLLAND			
	ST. JOSEPH			
	TO INDIANA STATE LINE			
	NEAR GRAND BEACH			
INDIANA	FROM MICHIGAN STATE LINE			
	VIA SOUTH BEND			
	PLYMOUTH			
	PERU			
	KOKOMO	REINFORCED AND		
	INDIANAPOLIS	PLAIN CONCRETE	238.43	
	COLUMBUS	MACADAM	11.99	
	SCOTTSBURG	UNIMPROVED	16.00	266.42
	NEW ALBANY			
	TO KENTUCKY STATE LINE			
KENTUCKY	FROM INDIANA STATE LINE AT			
	LOUISVILLE			
	VIA ELIZABETHTOWN			
	HORSE CAVE	BITUMINOUS		
	GLASGOW	MACADAM AND		
	SCOTTSVILLE	ROCK ASPHALT	132.00	132.00
	TO TENNESSEE STATE LINE			
TENNESSEE	FROM KENTUCKY STATE LINE			
	VIA LAFAYETTE			
	GALLATIN	CONCRETE, BITU-		
	NASHVILLE	MINOUS MACADAM		
	FRANKLIN	AND ROCK AS-		
	COLUMBIA	PHALT	106.34	
	PULASKI	GRAVEL	35.39	141.73
	TO ALABAMA STATE LINE			

UNITED STATES ROUTE 31 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
ALABAMA	FROM TENNESSEE STATE LINE			
	VIA ATHENS			
	DECATUR			
	CULLMAN	CONCRETE	48.13	
	BIRMINGHAM	BITUMINOUS MACADAM	68.53	
	MONTGOMERY	GRAVEL	98.32	
	HAYNEVILLE	GRADED AND DRAINED	193.84	
	GREENVILLE	UNIMPROVED	42.25	451.07
	GEORGIANA			
	EVERGREEN			
	BREWTON			
	TO MOBILE			
		TOTAL MILES		1,384.84

SUMMARY OF TYPES
UNITED STATES ROUTE 31

	MILES	PER CENT
CONCRETE, PLAIN AND REINFORCED, BITUMINOUS MACADAM AND ROCK ASPHALT	783.44	56.6
MACADAM	69.59	5.0
GRAVEL	219.09	15.8
EARTH AND GRADED AND DRAINED ROADS	193.84	14.0
UNIMPROVED	118.88	8.6
TOTAL	1,384.84	100.0

EXPLANATION OF ROUTE 1 MILEAGE

THE DETAILED MILEAGE IN UNITED STATES ROUTE 1 AS GIVEN IN THE APRIL NEWS LETTER TOTALLED 2,313.16 MILES WHILE THE SUMMARY SHOWED 2,321.14 MILES. THE DIFFERENCE OF 7.98 MILES CONSISTS OF FLORIDA CITY CONCRETE PAVEMENT ON AN OVERLAPPING ROUTE.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

STATUS OF CURRENT FEDERAL AID ROAD WORK

B.P.R.-F.A.-A-1
M-APRIL, 1927-A

FOR THE FISCAL YEAR ENDING JUNE 30, 1927

AS OF APRIL 30, 1927

STATES	BALANCE OF FEDERAL AID FUND AVAILABLE FOR NEW PROJECTS	* UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			AMOUNT PAID STATES DURING FISCAL YEAR	COMPLETED AND PAID DURING FISCAL YEAR			AGREEMENTS NOW IN FORCE			P.S.& E. RECOMMENDED FOR APPROVAL BY DISTRICT ENGINEER			STATES
		FEDERAL AID	MILES ORIGINAL	MILES STAGE	FEDERAL AID	MILES ORIGINAL	MILES STAGE		FEDERAL AID	MILES ORIGINAL	MILES STAGE	FEDERAL AID	MILES ORIGINAL	MILES STAGE	FEDERAL AID	MILES ORIGINAL	MILES STAGE	
ALABAMA	$ 3,017,687.90	$ 3,127,211.59	381.3		$ 136,675.57	14.3	1.9	$ 1,142,612.92	$ 889,114.85	101.9	4.6	$ 2,707,728.31	324.6		$ 556,158.85	71.0	1.9	ALABAMA
ARIZONA	3,334,270.17	791,184.87	73.0		176,216.27	11.7		530,897.83	508,799.34	48.6	0.4	791,184.87	73.0		176,216.27	11.7		ARIZONA
ARKANSAS	1,747,092.75	1,179,389.37	199.5		501,815.84	39.3		909,829.50	1,788,703.69	227.7		1,474,840.48	231.8		206,364.73	7.0		ARKANSAS
CALIFORNIA	4,261,537.81	3,419,674.51	152.9	0.4	37,146.93	2.1		2,734,704.27	3,834,300.45	240.6	17.3	3,116,824.35	136.1	0.4	339,997.09	18.9		CALIFORNIA
COLORADO	2,636,397.31	3,075,282.41	278.5	9.2	104,760.27	12.1		988,569.83	758,603.83	72.4		2,568,613.91	233.3	9.2	611,428.77	67.3		COLORADO
CONNECTICUT	789,838.92	1,575,579.88	70.4		94,641.66	0.3		599,215.20	245,719.74	13.7		1,530,168.33	69.9		140,053.21	0.8		CONNECTICUT
DELAWARE	180,807.05	361,826.40	31.7		63,316.77	8.4	1.9	316,664.52	452,067.18	28.0		361,826.40	31.7		63,316.77	8.4	1.9	DELAWARE
FLORIDA	1,181,124.55	3,777,276.07	186.3	24.8	398,091.78	24.2		767,812.15	1,803,550.28	112.1		3,344,828.19	177.9	24.8	830,539.66	32.6		FLORIDA
GEORGIA	1,270,668.08	4,546,622.72	398.3	110.9	217,323.56	8.3	8.5	2,104,488.69	2,712,309.78	307.6	44.1	3,998,904.89	354.5	85.7	765,041.39	62.1	33.7	GEORGIA
IDAHO	691,846.15	1,324,331.38	162.2	16.3	403,115.31	40.1	1.1	1,129,218.01	1,193,414.46	110.8	13.1	1,108,957.43	161.8	6.4	618,489.26	40.5	11.0	IDAHO
ILLINOIS	3,237,954.34	4,039,284.18	304.4		3,034,099.60	211.5		2,316,722.81	2,055,293.14	143.4	2.0	3,998,778.93	301.0		3,074,604.85	214.9		ILLINOIS
INDIANA	775,957.20	7,642,949.67	462.3	11.8	1,322,945.93	97.2		1,840,740.79	2,217,149.01	153.8		7,093,422.82	419.5	11.6	1,872,472.78	140.0		INDIANA
IOWA	189,306.84	6,346,201.12	536.9	208.8	1,814,732.08	110.6	38.4	2,493,039.93	2,254,019.86	331.0	50.8	8,747,858.20	609.8	240.7	413,075.00	37.6	6.6	IOWA
KANSAS	1,220,739.89	5,122,199.09	649.5	7.7	751,823.22	127.8	0.8	2,305,420.41	1,847,691.55	292.3		4,760,347.83	629.6	5.0	1,113,674.48	147.7	3.5	KANSAS
KENTUCKY	501,130.33	4,356,478.31	413.2	48.7	365,473.56	48.3	9.0	1,279,872.95	915,691.55	100.1	14.6	3,706,096.18	373.3	48.7	1,015,855.69	88.2	9.0	KENTUCKY
LOUISIANA	1,252,880.29	1,993,413.53	149.7		13,100.33	3.0		1,009,693.13	881,581.86	111.0		1,993,413.53	148.7		13,100.33	3.0		LOUISIANA
MAINE	1,421,868.90	821,344.43	63.4		43,956.00	5.6		863,450.78	665,945.28	54.0		865,300.43	68.0					MAINE
MARYLAND	662,052.09	373,185.64	33.8					615,466.66	411,947.05	54.5		373,185.64	33.9					MARYLAND
MASSACHUSETTS	2,374,833.28	1,367,469.57	83.2		193,770.00	12.9		608,733.90	604,492.53	24.9		1,341,853.22	82.4		219,386.35	13.7		MASSACHUSETTS
MICHIGAN	2,403,429.19	6,093,979.44	383.7	38.3	780,705.00	40.6	6.5	2,327,998.89	1,451,890.07	84.7		5,807,319.44	378.5	38.3	1,067,365.00	47.8	6.5	MICHIGAN
MINNESOTA	560,476.43	1,306,198.90	268.0	46.2	799,700.00	119.2	69.5	2,590,339.01	3,450,029.11	461.6	114.6	1,811,798.90	347.3	104.3	294,100.00	39.9	11.4	MINNESOTA
MISSISSIPPI	928,845.26	3,370,848.33	372.0		575,034.21	65.2	14.7	1,195,144.27	1,146,635.10	138.0		3,219,185.20	341.7		726,717.34	95.5	14.7	MISSISSIPPI
MISSOURI	1,366,401.01	4,319,947.16	286.4	40.9	791,595.43	84.3	12.9	3,471,980.04	4,977,652.55	344.1	22.9	3,758,403.06	255.3	36.1	1,353,139.53	115.4	17.7	MISSOURI
MONTANA	5,659,869.84	1,333,488.24	122.2	5.7	695,737.23	145.5		810,818.34	953,822.80	96.7	62.6	1,734,007.85	211.7	5.7	295,217.62	56.0		MONTANA
NEBRASKA	2,060,944.53	6,404,351.04	1,167.8	534.4	1,194,921.26	176.5	136.7	2,216,537.56	2,085,953.65	428.2	238.6	5,354,456.13	1,195.9	567.9	1,244,816.17	148.4	103.2	NEBRASKA
NEVADA	842,883.20	1,418,223.54	197.1	26.2				927,235.42	2,351,683.67	300.4	11.0	1,418,223.54	197.1	26.2				NEVADA
NEW HAMPSHIRE	372,148.42	303,802.51	18.7		95,178.55	7.4		418,361.52	386,537.45	26.4		303,802.51	18.7		96,178.55	7.4		NEW HAMPSHIRE
NEW JERSEY	336,842.96	970,846.60	59.8		598,976.96	42.8		732,592.69	2,397,022.27	26.0		960,133.56	62.0		609,690.00	40.6		NEW JERSEY
NEW MEXICO	1,633,005.86	2,684,953.75	240.6					868,371.92	501,532.01	71.4		1,840,471.61	203.3		844,482.14	37.3		NEW MEXICO
NEW YORK	5,569,430.40	9,080,878.95	565.2		1,762,927.50	98.9	8.6	4,244,991.56	3,355,217.96	216.8		10,160,863.95	626.3		682,942.50	37.8	8.6	NEW YORK
NORTH CAROLINA	1,333,412.57	1,267,381.42	79.3		517,189.75	34.3	12.2	2,086,961.22	3,135,240.32	189.3	37.6	1,402,381.42	81.2		382,189.75	22.4	12.2	NORTH CAROLINA
NORTH DAKOTA	720,844.14	2,426,064.74	642.5	61.4	1,056,417.74	264.8	331.7	2,417,164.02	1,708,423.60	522.3	362.9	2,732,717.56	708.2	157.7	749,764.92	199.1	235.4	NORTH DAKOTA
OHIO	4,553,632.77	4,389,902.25	329.8	4.1	219,093.22	12.8		2,466,624.45	1,959,589.73	150.9	13.5	4,119,640.15	321.9	4.1	489,355.32	20.7		OHIO
OKLAHOMA	1,527,980.78	1,366,962.43	203.9	17.9	898,603.25	119.1	20.7	1,182,493.78	858,132.39	73.8	10.1	1,882,397.64	265.8	30.8	383,168.04	67.2	7.7	OKLAHOMA
OREGON	709,878.94	1,402,557.40	66.4	35.8	199,706.35	24.9		1,129,676.98	1,156,191.52	97.1		1,362,564.70	66.4	36.8	239,699.06	24.9		OREGON
PENNSYLVANIA	3,031,805.01	4,483,937.98	304.5		1,458,563.84	83.3		2,950,110.62	4,139,477.13	303.9		5,366,172.39	355.3		576,329.43	32.5		PENNSYLVANIA
RHODE ISLAND	591,239.94	205,666.00	13.7		237,810.00	16.8		466,686.24	439,650.00	29.3		279,840.00	18.6		163,635.00	10.9		RHODE ISLAND
SOUTH CAROLINA	645,897.83	2,575,506.55	209.2	14.0	108,118.82	21.4		916,711.98	760,665.87	86.6	15.4	2,203,095.06	175.4	8.0	480,630.31	55.2	6.0	SOUTH CAROLINA
SOUTH DAKOTA	903,306.33	1,717,631.55	676.1	12.0	326,014.91	130.6	60.7	1,027,855.94	836,074.24	284.2	154.4	1,708,097.91	571.7	56.3	335,548.55	135.0	16.4	SOUTH DAKOTA
TENNESSEE	1,885,627.52	3,468,402.56	235.6	42.8	35,000.00	0.3		1,685,086.98	1,229,742.90	78.6	19.1	3,324,814.29	212.9	42.8	178,588.27	23.0		TENNESSEE
TEXAS	6,197,557.28	6,831,169.89	527.5	190.1	813,238.16	68.7	50.9	4,054,568.01	3,821,492.96	531.8	27.1	6,391,474.02	509.7	176.6	1,262,824.03	86.5	64.4	TEXAS
UTAH	1,142,636.52	1,672,855.84	161.8		83,112.69	11.6		636,531.72	668,639.27	82.5		1,493,855.12	153.9		262,113.41	19.6		UTAH
VERMONT	314,662.47	664,170.08	25.9		422,028.44	26.9		607,226.94	316,571.50	17.2		564,170.08	25.9		422,028.44	26.9		VERMONT
VIRGINIA	180,489.45	1,996,653.04	113.1		393,530.29	21.9	4.0	1,720,734.77	1,987,927.11	149.7		1,616,353.47	90.8		773,729.86	44.2	4.0	VIRGINIA
WASHINGTON	1,229,654.67	1,760,600.00	68.2		50,501.38	10.2		1,057,959.01	463,642.49	42.5		1,750,600.00	68.2		60,501.38	10.2		WASHINGTON
WEST VIRGINIA	583,218.82	2,934,191.85	238.2	12.1	54,988.32	5.7		576,539.15	432,685.36	28.5		2,773,686.36	223.2	12.1	215,494.81	20.7		WEST VIRGINIA
WISCONSIN	2,929,855.05	3,283,441.30	301.8	14.1	1,379,265.50	86.9	20.8	2,347,849.67	1,324,002.42	124.1	7.8	3,018,482.09	286.7	6.8	1,843,224.71	101.8	28.1	WISCONSIN
WYOMING	1,112,768.04	1,025,687.63	104.2	33.7	222,920.28	34.5		696,804.42	1,098,380.00	182.4	32.8	1,025,687.63	104.2	33.7	222,920.28	34.6		WYOMING
HAWAII	805,976.36	562,362.64	29.7					216,626.47	97,440.00	6.5		562,362.64	29.7					HAWAII
TOTAL	$ 82,882,714.44	$ 134,453,457.36	12,543.3	1,568.2	$ 26,443,983.78	2,531.7	811.5	$ 72,603,625.77	$ 76,541,240.87	7,701.8	1,277.0	$ 131,832,171.22	12668.3	1,775.8	$ 28,066,169.88	2,606.7	603.9	TOTAL

* INCLUDES PROJECTS REPORTED COMPLETED (FINAL VOUCHERS NOT YET PAID) TOTALING — FEDERAL AID $30,999,666.81 MILES ORIGINAL 2,721.6 MILES STAGE 391.1

OHIO FORM-SETTING METHOD FOR CONCRETE PAVEMENT CURVES

CONTRIBUTED BY JAMES H. STONE OF THE DIVISION OF DESIGN

NEW STANDARD CONSTRUCTION DRAWINGS JUST ISSUED BY THE OHIO DEPARTMENT OF HIGHWAYS DESCRIBE IN DETAIL A METHOD OF SETTING FORMS FOR SUPERELEVATED AND WIDENED CURVES IN CONCRETE PAVEMENTS WHICH MAKES POSSIBLE THE MACHINE FINISHING OF THE PAVEMENT AT CURVES WITHOUT DELAYING, STOPPING, OR ADJUSTING THE FINISHING MACHINE.

IN ACCORDANCE WITH THE NEW OHIO POLICY ALL CURVES OF ONE DEGREE AND OVER WILL BE SUPERELEVATED BY REVOLVING THE CROSS SECTION OF THE PAVEMENT ABOUT ITS INNER EDGE AS AN AXIS, AND CURVES OF 5 DEGREES AND OVER WILL BE WIDENED.

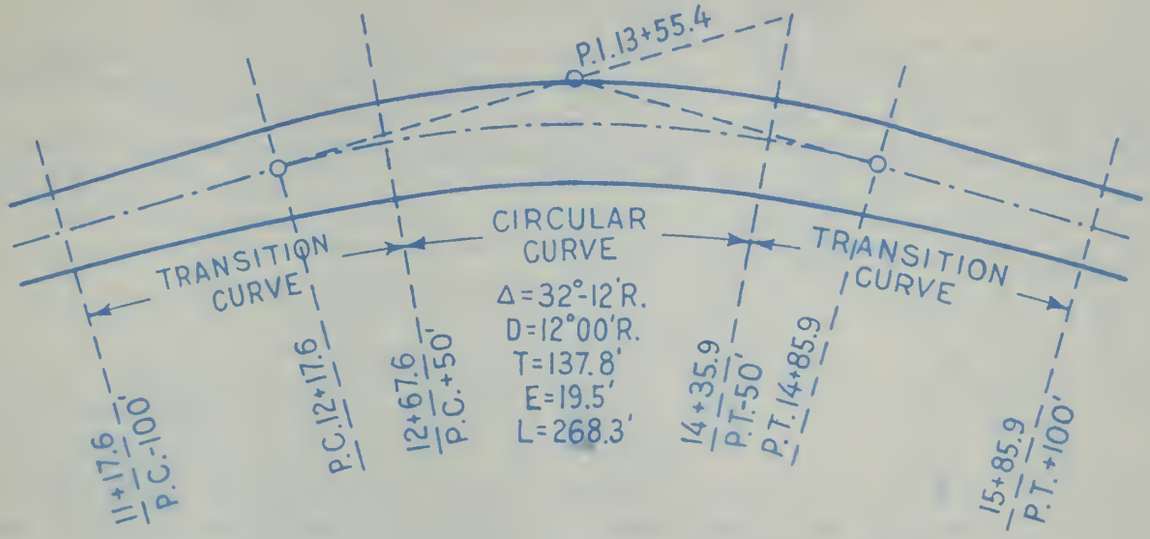
ON THE WIDENED SECTIONS MACHINE FINISHING OF THE MAJOR PORTION OF THE PAVEMENT IS MADE POSSIBLE BY SETTING A SUPPLEMENTAL FORM AT A DISTANCE FROM THE INNER EDGE EQUAL TO THE NORMAL TANGENT WIDTH OF THE PAVEMENT, LEAVING ONLY THE LUNE BETWEEN THE SUPPLEMENTAL AND OUTER-EDGE FORMS TO BE FINISHED BY HAND.

THE MANNER IN WHICH THE FORMS ARE SET, AS DESCRIBED IN THE CONSTRUCTION DRAWINGS RECENTLY ISSUED IS OUTLINED IN SUBSTANCE AS FOLLOWS:

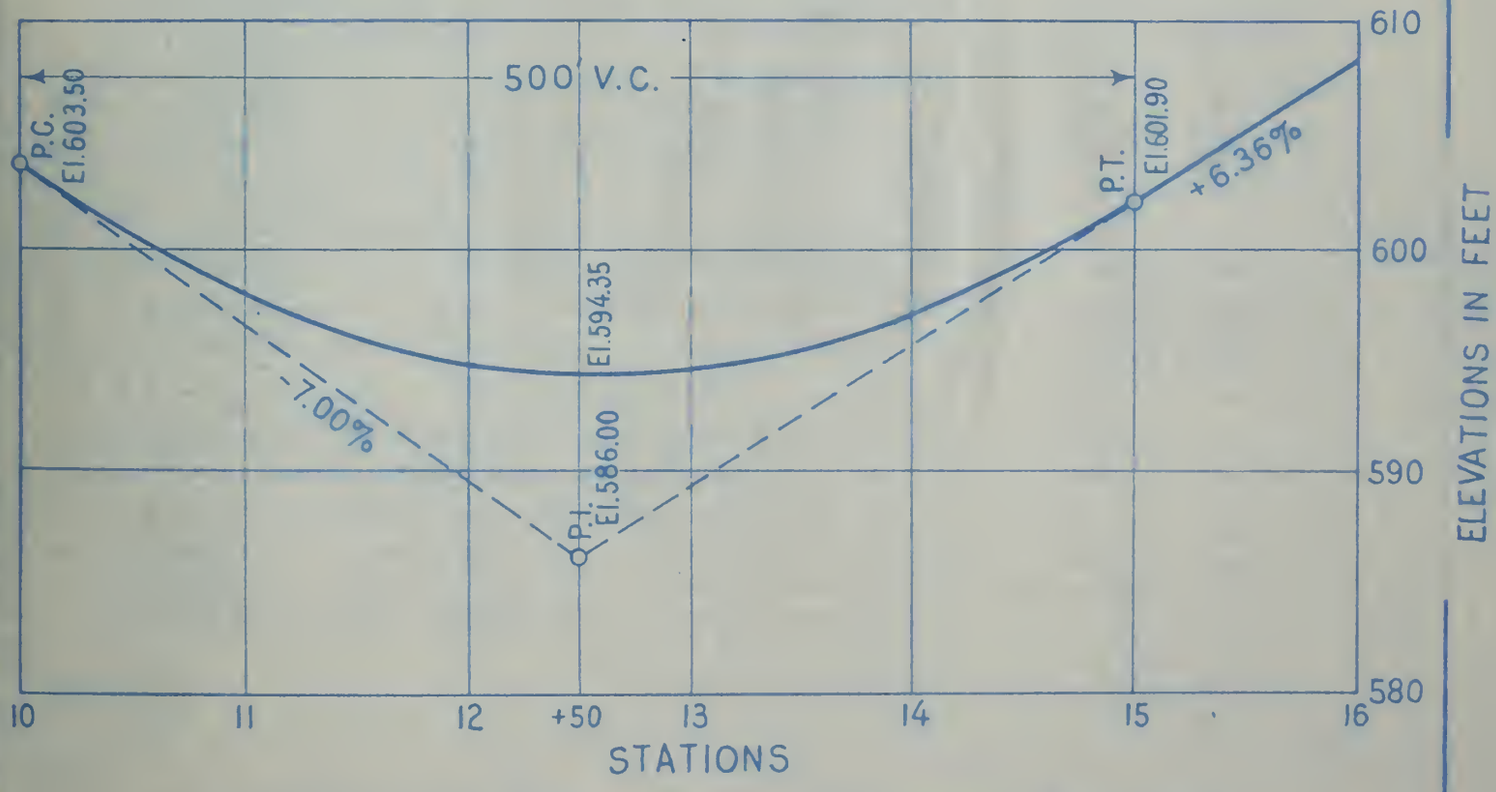
DESCRIPTION OF METHOD

THE CENTER LINE OF THE ROAD AT CURVES IS REPRESENTED ON ALL PLANS AS A SIMPLE CURVE. THIS LINE IS FIRST STAKED OUT ON THE GROUND, AND LINE AND GRADE STAKES FOR THE EDGE AND SUPPLEMENTAL FORMS ON THE WIDENED AND SUPERELEVATED SECTION ARE SET FROM THIS SIMPLE CURVE AS A BASE.

BOTH WIDENING AND SUPERELEVATION BEGIN AT A POINT ON THE APPROACH TANGENT 100 FEET BACK OF THE P.C. OF THE SIMPLE CURVE (FIG. 1A). FROM THAT POINT ON THE CENTER LINE THE POSITION OF THE INNER-EDGE FORM IS ESTABLISHED BY MEASURING OVER ONE-HALF OF THE NORMAL TANGENT WIDTH OF THE PAVEMENT AND SETTING THE FORM AT AN ELEVATION BELOW THE CENTER GRADE EQUAL TO THE TOTAL NORMAL CROWN OF THE PAVEMENT. FROM THIS POINT THE POSITION OF THE INNER-EDGE OF THE PAVEMENT IS LOCATED BY MEANS OF A SERIES OF OFFSETS AT 10-FOOT INTERVALS, FROM THE ESTABLISHED CENTER LINE. THE REQUIRED OFFSETS FOR CURVES OF 5 TO 29 DEGREES ARE GIVEN IN A TABLE PREPARED BY THE DEPARTMENT WHICH IS REPRODUCED HERE AS TABLE 1. THESE OFFSETS DEFINE A TRANSITION CURVE FOR THE INNER EDGE OF THE PAVEMENT WHICH BEGINS AT THE POINT 100 FEET BACK OF THE P.C. AND ENDS AT A POINT 50 FEET BEYOND THE P.C. WHERE IT CONNECTS WITH A SIMPLE CURVE CONCENTRIC WITH THE CENTER-LINE CURVE. IN ADDITION TO FORMING A TRANSITION CURVE THIS PROCEDURE ALSO ACCOMPLISHES THE WIDENING OF THE PAVEMENT BY ADDING THE REQUIRED EXTRA WIDTH TO THE INNER SIDE OF THE CURVE.



a-LAYOUT OF SIMPLE CURVE AND COMPUTED TRANSITION CURVES



b-PROFILE OF CENTER LINE OF PAVEMENT AT CROWN

FIGURE-1

Table 1. - Computed Extra Widths of Pavement at 100-foot Intervals and Superelevation in Feet per Foot of Pavement Width for Curves of Various Degrees

Curvature	Radius*	Perpendicular offsets from inner edge of pavement in feet on tangent or Radial offsets from inner edge of pavement in feet on curve. Distances from P.C. -100 feet or P.T. +100 feet														Superelevation per foot of pavement width for all grades	Area of transition sections	Area of extra pavement per 100 lineal feet of simple curve (normal width-18 ft)
		10 Ft	20 Ft	30 Ft	40 Ft	50 Ft	60 Ft	70 Ft	80 Ft	90 Ft	100 Ft	110 Ft	120 Ft	130 Ft	140 Ft	150 Ft		
Degrees	Feet																Feet	Square Feet	Square Feet
1	5729.58																0.018		
2	2864.79				Pavement on curves of less than 5 degrees												.027		
3	1909.86				will be superelevated but not widened												.036		
4	1432.39																.045		
5	1145.92	0.01	0.04	0.10	0.17	0.27	0.39	0.53	0.69	0.89	1.15	1.41	1.64	1.82	1.94	2.00	.054	239	198
6	954.93	0.01	0.05	0.12	0.21	0.33	0.47	0.64	0.83	1.06	1.35	1.63	1.88	2.06	2.19	2.25	.063	277	222.7
7	818.51	0.01	0.06	0.14	0.24	0.38	0.55	0.75	0.97	1.24	1.56	1.86	2.11	2.31	2.44	2.50	.064	315	247.0
8	716.20	0.02	0.07	0.16	0.28	0.44	0.63	0.85	1.11	1.41	1.76	2.08	2.35	2.55	2.69	2.75	.065	353	271.2
9	636.62	0.02	0.08	0.18	0.31	0.49	0.71	0.96	1.25	1.59	1.96	2.31	2.59	2.80	2.94	3.00	.067	390	295.4
10	572.96	0.02	0.09	0.20	0.34	0.54	0.78	1.05	1.37	1.74	2.15	2.53	2.83	3.04	3.19	3.25	.068	425	319.4
11	520.67	0.02	0.10	0.21	0.37	0.59	0.85	1.15	1.49	1.90	2.34	2.75	3.06	3.29	3.43	3.50	.069	460	343.3
12	477.46	0.03	0.10	0.23	0.40	0.63	0.92	1.24	1.62	2.05	2.53	2.97	3.30	3.53	3.68	3.75	.071	495	367.1
13	440.74	0.03	0.11	0.25	0.43	0.68	0.98	1.33	1.74	2.21	2.72	3.19	3.53	3.77	3.93	4.00	.072	530	390.9
14	409.26	0.03	0.12	0.27	0.46	0.73	1.05	1.43	1.86	2.36	2.91	3.41	3.77	4.01	4.18	4.25	.074	565	414.5
15	381.97	0.03	0.13	0.28	0.49	0.78	1.12	1.52	1.98	2.51	3.10	3.63	4.00	4.26	4.42	4.50	.075	600	438.0
16	358.10	0.03	0.13	0.30	0.52	0.82	1.19	1.61	2.10	2.67	3.29	3.85	4.24	4.50	4.67	4.75	.076	634	461.5
17	337.03	0.04	0.14	0.32	0.55	0.87	1.26	1.71	2.23	2.82	3.48	4.07	4.47	4.74	4.92	5.00	.078	668	484.8
18	318.31	0.04	0.15	0.33	0.58	0.92	1.33	1.80	2.35	2.98	3.67	4.29	4.71	4.99	5.16	5.25	.079	702	508.0
19	301.56	0.04	0.16	0.35	0.62	0.97	1.40	1.90	2.47	3.13	3.87	4.52	4.95	5.23	5.41	5.50	.081	735	531.1
20	286.48	0.04	0.16	0.37	0.65	1.01	1.46	1.99	2.59	3.28	4.06	4.74	5.18	5.47	5.66	5.75	.082	769	554.1
21	272.84	0.04	0.17	0.38	0.68	1.06	1.53	2.08	2.71	3.44	4.25	4.96	5.42	5.71	5.90	6.00	.083	803	577.0
22	260.44	0.05	0.18	0.40	0.71	1.11	1.60	2.18	2.84	3.59	4.44	5.18	5.65	5.95	6.15	6.25	.086	837	599.8
23	249.11	0.05	0.19	0.42	0.74	1.16	1.67	2.27	2.96	3.75	4.63	5.40	5.89	6.20	6.40	6.50	.089	871	622.4
24	238.73	0.05	0.19	0.44	0.77	1.20	1.74	2.36	3.08	3.90	4.82	5.62	6.12	6.44	6.65	6.75	.091	905	645.0
25	229.18	0.05	0.20	0.45	0.80	1.25	1.81	2.46	3.20	4.06	5.01	5.84	6.36	6.68	6.89	7.00	.094	938	667.4
26	220.37	0.05	0.21	0.47	0.83	1.30	1.87	2.55	3.32	4.21	5.20	6.06	6.59	6.92	7.14	7.25	.096	971	689.7
27	212.21	0.06	0.22	0.49	0.86	1.35	1.94	2.64	3.45	4.36	5.39	6.28	6.83	7.17	7.39	7.50	.099	1004	711.9
28	204.63	0.06	0.22	0.50	0.89	1.39	2.01	2.74	3.57	4.52	5.58	6.50	7.06	7.41	7.63	7.75	.102	1037	734.0
29	197.57	0.06	0.23	0.52	0.92	1.44	2.08	2.83	3.69	4.67	5.77	6.72	7.30	7.65	7.88	8.00	.104	1070	756.0

* In computing the radius it is considered that the central angle in degrees subtends 100 feet of actual arc on the curve

Having located the inner-edge form, an intermediate or supplemental form is placed on which the wheel or trunnion of the finishing machine may run without stopping or slowing the machine, changing the gauge of the wheels or the crown of the pavement. The elevation of the supplemental form is calculated as illustrated by Figure 2b and 2c and it is set at the normal pavement width from the inner-edge form. The superelevation of the supplemental form provides for a smooth curve on the pavement surface from the inner-edge form across the outer lune to the outside-edge form. The normal crown is preserved between the inner-edge form and the supplemental form. The lune section is finished with a straight screed.

The outer-edge form is set at one-half the normal pavement width from the original staked center line and at the superelevation given in Table 2 which is calculated from the values shown in Table 1.

In a similar manner the superelevation and widening is accomplished beginning at a point on the simple curve 50 feet from the P.T. and extending for a distance of 100 feet along the tangent. This scheme provides for a transition curve 150 feet long at each end of all simple curves which are 100 feet or more in length. The portion of the curve, if any, between the transition sections is superelevated and widened the maximum required amount.

Example showing method of computing widening and superelevation

As an example of the procedure consider that two tangents meet at a point of intersection with an external angle of 32° 12' to the right. (Figure 1a) and that an external distance of approximately 20 feet is desired. The station of the point of intersection is 13 + 55.4. By using the functions of a 1-degree curve it is found that the external for a 32° - 12' angle is 233.9 feet and dividing this by the approximate external distance (20 feet) gives a value for the curve of 11.695 degrees. It is satisfactory to use the closest practicable figure of 12 degrees. The functions of the simple curve computed on this basis are as follows:

External distance $\frac{233.9}{12}$ = 19.49 feet

Tangent distance $\frac{1653.9}{12}$ = 137.82 feet

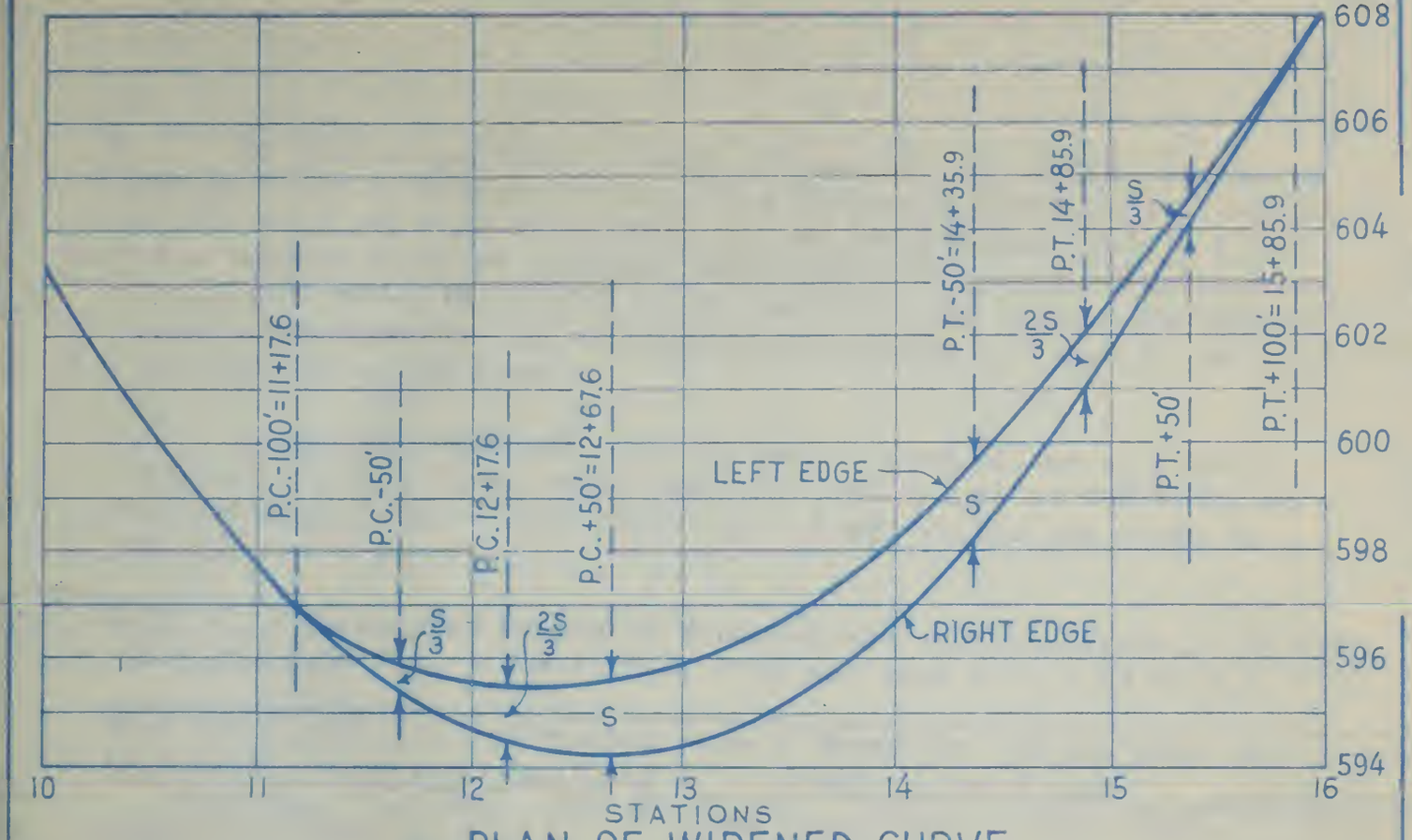
Length of curve $\frac{32^{\circ}-12'}{12^{\circ}} \times 100 = 268.3$ feet

P.C. = 12 + 17.6

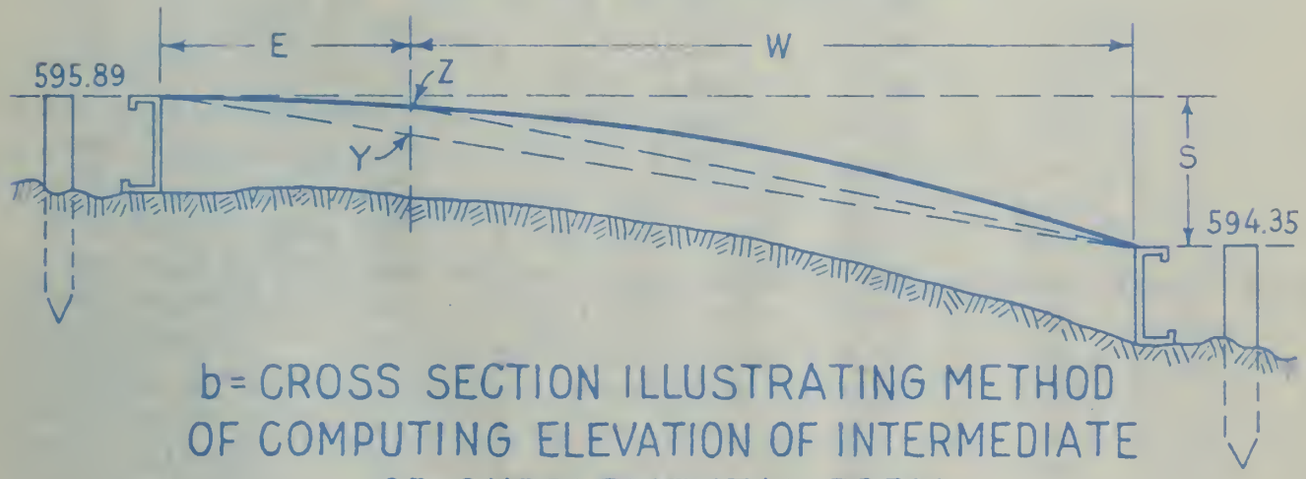
P.T. = 14 + 85.9

P.C. - 100 = 11 + 17.6 (Beginning of superelevation and widening)

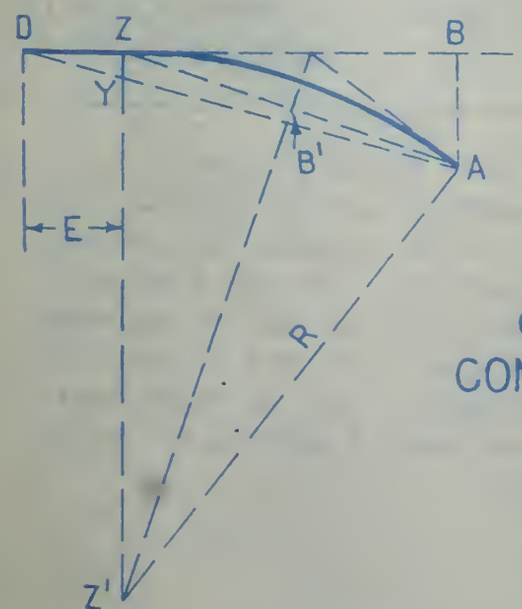
P.T. + 100 = 15 + 85.9 (Ending " " " ")



a = PLAN OF WIDENED CURVE



b = CROSS SECTION ILLUSTRATING METHOD OF COMPUTING ELEVATION OF INTERMEDIATE OR SUPPLEMENTAL FORM



C = SKETCH SHOWING METHOD OF COMPUTING EXTRA ELEVATION IN TABLE 4

FIGURE-2

By consulting Table I it is found that the superelevation in feet per foot of pavement width for a 12-degree curve on all grades is .071 feet and that the maximum amount of widening is 3.75 feet. For a tangent width of pavement of 18 feet, the maximum superelevation (S) is then (18 + 3.75) x .071 feet or 1.54 feet. The proportional superelevation is then computed from the distance of the plus from the end of the curve.

Since the procedure provides that stakes be set at 25-foot intervals the next step is to calculate the values of the widening and superelevation by interpolation. These values are given in Table 2.

Table 2. - Calculated values of widening and superelevation at 25 foot stations from P.C. - 100 to P.C. + 50 and from P.T. - 50 to P.T. +100

Plus -(P.C.-100): (P.T.+100)- plus: Stations	Interval: Feet	Given from Table I: Plus = Feet:	Widening Interpolated: Feet	Given from Table I: Plus = Feet:	Proportional superelevation: Feet
11+17.6-11+17.6	0.0				0.0
+25 -11+17.6	7.4	0 = 0.00	0.02	10 = 0.03	0.08
+50 -11+17.6	32.4	30 = 0.23	0.27	40 = 0.40	0.33
+75 -11+17.6	57.4	50 = 0.63	0.84	60 = 0.92	0.59
12+00 -11+17.6	82.4	80 = 1.62	1.72	90 = 2.05	0.85
+25 -11+17.6	107.4	100 = 2.53	2.86	110 = 2.97	1.10
+50 -11+17.6	132.4	130 = 3.53	3.57	140 = 3.68	1.36
+67.6-11+17.6	150.0	150 = 3.75	3.75	150 = 3.75	1.54
Maximum superelevation and widening maintained around simple curve					
15+85.9-14+35.9	150	150 = 3.75	3.75	150 = 3.75	1.54
15+85.9-14+50	135.9	130 = 3.53	3.62	140 = 3.68	1.40
15+85.9-14+75	110.9	110 = 2.97	3.00	120 = 3.30	1.14
15+85.9-15+00	85.9	80 = 1.62	1.87	90 = 2.05	0.88
15+85.9-15+25	60.9	60 = 0.92	0.95	70 = 1.24	0.63
15+85.9-15+50	35.9	30 = 0.23	0.33	40 = 0.40	0.37
15+85.9-15+75	10.9	10 = 0.03	0.04	20 = 0.10	0.11
15+85.9-15+85.9	0.0	0 = 0.0	0.0	0 = 0	0.0

Table 3 gives the values of the grade at the center line at the surface of the pavement. As may be seen from Figure 18 these grades are calculated on a 500-foot vertical curve at the intersection between a minus 7 per cent and a plus 6.36 per cent grade. The termini of the vertical curve do not correspond necessarily with the termini of the superelevation and widening. The elevation of the right edge of the pavement in Table 3 is computed by subtracting the crown (0.15 feet) from the profile grade at the center line. The

WIDENING COMPUTED IN TABLE 2 IS SHOWN ADDED ON THE INNER SIDE OF THE CURVE TO ONE-HALF THE WIDTH OF THE PAVEMENT ON THE TANGENT. THE PROPORTIONAL SUPERELEVATION IS ADDED TO THE ELEVATION OF THE RIGHT EDGE OF THE PAVEMENT IN ORDER TO DETERMINE THE ELEVATION OF THE LEFT EDGE OF THE PAVEMENT.

TABLE 3. - CALCULATED ELEVATION OF RIGHT AND LEFT EDGES OF PAVEMENT AND WIDENING AT 25-FOOT INTERVALS BEGINNING AT P.C.-100 AND ENDING AT P.T.+100. CROWN CONSIDERED AS 0.15 FEET

	Center profile	Right pavement edge		Proportional	Left pavement edge	
Station	grade elevation	Elevation	Widening	superelevation	Elevation	Widening
	Feet	Feet	Feet	Feet	Feet	Feet
11+17.6	597.12	596.97	9.00	0.0	596.97	9.00
+25	596.84	596.69	9.02	0.08	596.77	9.00
+50	596.01	595.86	9.27	0.33	596.19	9.00
+75	595.34	595.19	9.84	0.59	595.78	9.00
12+00	594.84	594.69	10.72	0.85	595.54	9.00
+25	594.51	594.36	11.86	1.10	595.46	9.00
+50	594.35	594.20	12.57	1.36	595.56	9.00
+67.6	594.34	594.19	12.75	1.54	595.73	9.00
+75	594.35	594.20	12.75	1.54	595.74	9.00
13+00	594.52	594.37	12.75	1.54	595.91	9.00
+25	594.86	594.71	12.75	1.54	596.25	9.00
+50	595.37	595.22	12.75	1.54	596.76	9.00
+75	596.04	595.89	12.75	1.54	597.43	9.00
14+00	596.88	596.73	12.75	1.54	598.27	9.00
+25	597.88	597.73	12.75	1.54	599.27	9.00
+35.9	598.37	598.22	12.75	1.54	599.76	9.00
+50	599.05	598.90	12.62	1.40	600.30	9.00
+75	600.38	600.24	12.00	1.14	601.38	9.00
15+00	601.90	601.75	10.87	0.88	602.63	9.00
+25	603.49	603.34	9.95	0.63	603.97	9.00
+50	605.08	604.93	9.33	0.37	605.30	9.00
+75	606.67	606.52	9.04	0.11	606.63	9.00
15+85.9	607.36	607.21	9.00	0.0	607.21	9.00

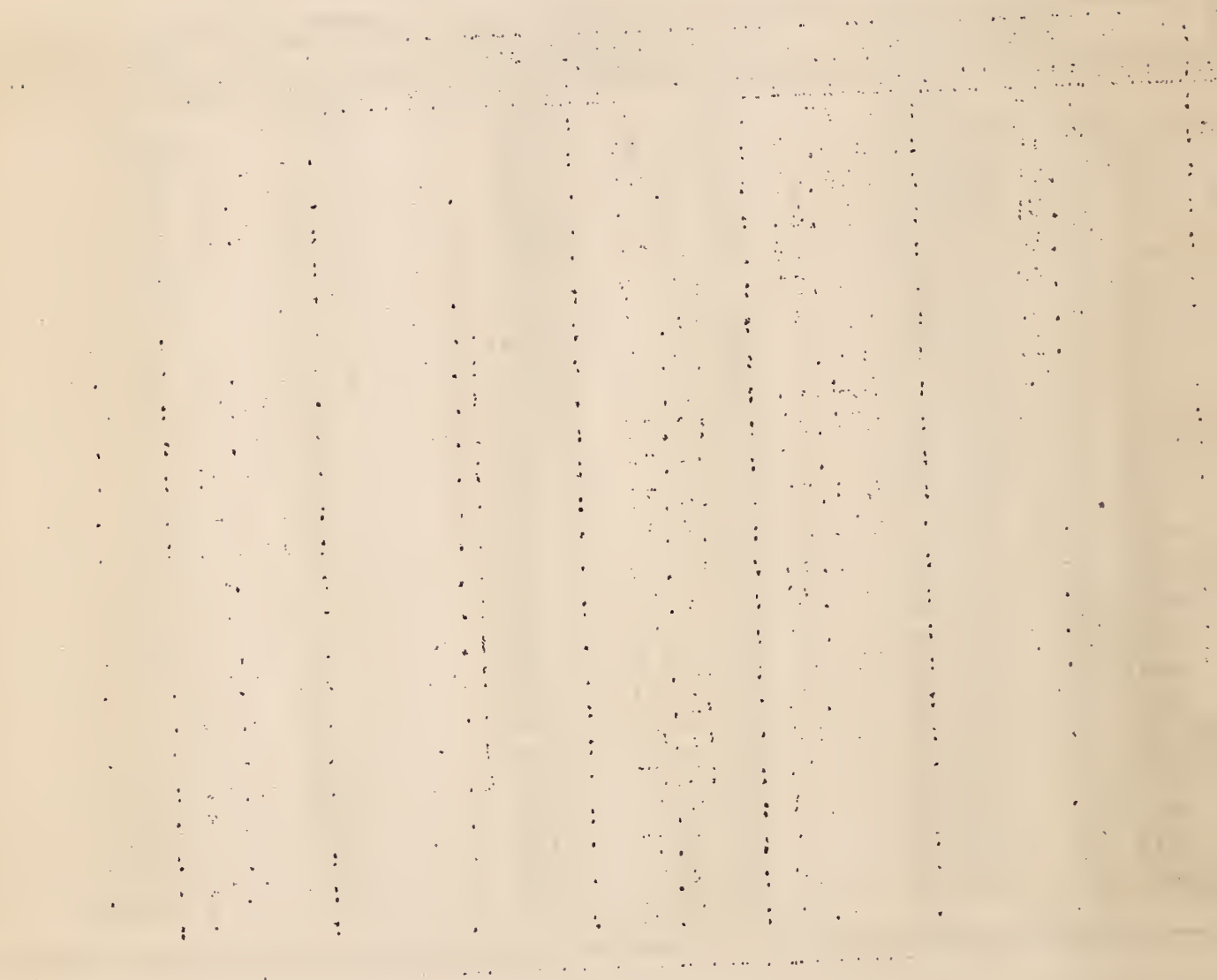


TABLE 4. - EXTRA ELEVATION IN FEET AND INCHES TO BE ADDED TO ELEVATION OF POINT Y TO DETERMINE ELEVATION OF TOP OF SUPPLEMENTAL FORM AT Z

EXTRA WIDTH	EXTRA ELEVATION FOR DIFFERENT PAVEMENT WIDTHS			EXTRA ELEVATION FOR DIFFERENT PAVEMENT WIDTHS		
	16 FEET	18 FEET	20 FEET	16 FEET	18 FEET	20 FEET
FEET	INCHES	INCHES	INCHES	FEET	FEET	FEET
0.25	3/32	3/32	3/32	.01	.01	.01
0.50	3/16	3/16	3/16	.02	.02	.02
0.75	9/32	9/32	9/32	.02	.02	.02
1.00	11/32	3/8	3/8	.03	.03	.03
.25	7/16	15/32	15/32	.04	.04	.04
.50	1/2	17/32	9/16	.04	.04	.05
.75	19/32	5/8	21/32	.05	.05	.05
2.00	21/32	11/16	23/32	.06	.06	.06
.25	3/4	25/32	13/16	.06	.06	.07
.50	13/16	27/32	7/18	.07	.07	.07
.75	7/8	15/16	31/32	.07	.08	.08
3.00	15/16	1	1-1/32	.08	.08	.09
.25	1	1-1/16	1-1/8	.08	.09	.09
.50	1-1/16	1-1/8	1-3/16	.09	0.10	0.10
.75	1-1/8	1-7/32	1-1/4	.09	0.10	0.11
4.00	1-3/16	1-9/32	1-11/32	0.10	0.11	0.11
.25	1-1/4	1-11/32	1-13/32	0.10	0.11	0.12
.50	1-5/16	1-13/32	1-15/32	0.11	0.12	0.12
.75	1-3/8	1-15/32	1-17/32	0.11	0.12	0.13
5.00	1-7/16	1-17/32	1-19/32	0.12	0.13	0.13
.25	1-15/32	1-19/32	1-21/32	0.12	0.13	0.14
.50	1-17/32	1-5/8	1-23/32	0.13	0.14	0.14
.75	1-19/32	1-11/16	1-25/32	0.13	0.14	0.15
6.00	1-5/8	1-3/4	1-27/32	0.14	0.15	0.15
.25	1-11/16	1-13/16	1-29/32	0.14	0.15	0.16
.50	1-23/32	1-27/32	1-31/32	0.14	0.15	0.16
.75	1-25/32	1-29/32	2-1/32	0.15	0.16	0.17
7.00	1-13/16	1-31/32	2-1/16	0.15	0.16	0.17
.25	1-7/8	2	2-1/8	0.16	0.17	0.18
.50	1-29/32	2-1/16	2-3/16	0.16	0.17	0.18
.75	1-31/32	2-3/32	2-7/32	0.16	0.18	0.19
8.00	2	2-5/32	2-9/32	0.17	0.18	0.19

Having determined the location and elevation of the right and left outside-edge forms it is next necessary to calculate the proper elevation for the intermediate or supplemental form.

Figure 2 illustrates the problem and Table 4 gives the calculated values of the difference in elevation between the supplemental and outside-edge form for various amounts of widening and for three pavement widths. Table 4 is used as follows:

Given

W(width of pavement) = 18.00 feet

E(amount of widening) = 3.75 "

S(total superelevation) = 1.54 "

Then the elevation of the point Y (fig. 2c) is equal to

$595.89 - \frac{3.75 \times 1.54}{21.75} = 595.62$. From Table 4, for 3.75 feet of widening on an 18-foot pavement, the extra elevation (YZ) is equal to 0.10 feet. Then 595.62 + 0.10 = 595.72 equals the elevation of the point Z which coincides with the top of the supplemental form. Similarly the elevations of the supplemental form are computed as given in Table 5.

This calculation may be formulated as follows:

Let Z = elevation of the top of supplemental form at any given station

T = extra elevation in feet YZ

I = elevation of inner-edge form (profile grade at center minus crown in feet)

Then $Z = I + T + S - \frac{S\,E}{W+E}$

TABLE 5. - COMPUTED ELEVATIONS OF TOP OF SUPPLEMENTAL FORM AT EVEN 25-FOOT STATIONS

STATION	ELEVATION OF OUTSIDE PAVEMENT-EDGE	$\frac{E\ S}{W+E}$	ELEVATION OF POINT Y	EXTRA ELEVATION Y Z	ELEVATION OF SUPPLEMENTAL FORM AT Z
	FEET	FEET	FEET	FEET	FEET
11 + 47.6	596.97	0.0	596.97	0.0	596.97
+ 25	596.77	0.01	596.76	0.0	596.76
+ 50	596.19	0.06	596.13	0.01	596.14
+ 75	595.78	0.10	595.68	0.02	595.70
12 + 00	595.54	0.15	595.39	0.05	595.44
+ 25	595.46	0.19	595.27	0.08	595.35
+ 50	595.56	0.24	595.32	0.10	595.42
+ 67.6	595.73	.27	595.46	0.10	595.56
+ 75	595.74	.27	595.47	0.10	595.57
13 + 00	595.91	.27	595.64	0.10	595.74
+ 25	596.25	.27	595.98	0.10	596.08
+ 50	596.76	.27	596.49	0.10	596.59
+ 75	597.43	.27	597.16	0.10	597.26
14 + 00	598.27	.27	598.00	0.10	598.10
+ 25	599.27	.27	599.00	0.10	599.10
+ 35.9	599.76	.27	599.49	0.10	599.59
+ 50	600.30	0.24	600.06	0.10	600.16
+ 75	601.38	0.20	601.18	0.08	601.26
15 + 00	602.63	0.15	602.48	0.05	602.53
+ 25	603.97	0.11	603.86	0.03	603.89
+ 50	605.30	0.06	605.24	0.01	605.25
+ 75	606.63	0.02	606.61	0.0	606.61
15 + 85.9	607.21	0.0	607.21	0.0	607.21

THIS COMPLETES THE CALCULATIONS FOR THE CURVE. THE RIGHT AND LEFT OUTSIDE-EDGE FORMS ARE STAKED OUT FROM THE DATA GIVEN IN TABLE 3 AND THE SUPPLEMENTAL FORM IS LOCATED FROM THE FIGURES IN TABLE 5 AND AT THE NORMAL PAVEMENT WIDTH FROM THE INNER-EDGE FORM.

Method of Computing Table 4

Referring to Figure 2c the basic data in Table 4 is computed as follows:

Given: Z A = 20.0 feet or 240 inches

Crown = 2 inches

Then $R^2 - (R-2)^2 = (120)^2$

R = 3601 inches

Triangles Z B A and Z'B'A are similar

Therefore 3601:240 :: 120:BA

$BA = \frac{240 \times 120}{3601}$ or 7.998 inches. Use 8 inches

Since Crown = 2 inches. B A = 4 x Crown

$ZB = \sqrt{(240)^2 - (8)^2} = 239.87$ inches. Use 240 inches

Then D B:D Z :: B A : Y Z

Since W = width of pavement in feet

E = extra width " "

C = crown in inches

Then $YZ = \frac{4\,C\,E}{W + E}$ = extra elevation in inches

Method of Constructing Extra Width

The Ohio scheme involving the supplemental form makes necessary a special method for placing the extra width or lune concrete. During the past season the State highway department permitted the practice of two methods, either: (a) Simultaneous mixing or depositing of the lune concrete; or (b) subsequent mixing and pouring from a small independent mixing outfit. In both cases the lune is finished by hand methods, but the mechanical finisher is not delayed nor its gauge, adjustment or operation changed or interfered with. In the first method, the supplemental form is removed section by section, immediately after the passage of the finishing machine. By this practice the concrete edge may be kept fresh so as to unite monolithically with the lune concrete. The concrete for the extra width is carried back from the main mixer by hand equipment or deposited by the bucket and broom of the mixer where possible.

In the second method the supplemental form is usually left in place until after the final set of the main pavement. The lune is then poured and finished non-monolithically. In this case the ends of the lune are not feathered usually but are blunted at the ends to a width of one foot or more.

Louisiana Transferred to District 8

Effective June 1, the administration of Federal-aid road work for the State of Louisiana has been transferred from District 6 to District 8.

All correspondence with reference to the Louisiana work should be addressed in the future to the Montgomery district office.

United States Department of Agriculture
Bureau of Public Roads

B-1 (1926)
R.S.A.

STATE HIGHWAY BONDS (1)

Accumulative Bond Status From First Issue to End of Fiscal Year 1926.

States With Bonds Outstanding During Year	Fiscal Year Ends	Year First Authorized	TOTAL BONDS AUTHORIZED Omitting Refund Bonds	TOTAL BONDS ISSUED, Including Refund Bonds	TOTAL BONDS RETIRED, To end of Fiscal Year	NET BONDS OUTSTANDING, Including Refund Bonds	SINKING FUND Balance Accrued end Fiscal Year	NET BONDED INDEBTEDNESS (Outstanding less Sinking Fund)
Alabama	9/30	1922	$ 25,000,000	$ 23,000,000	$ 2,200,000	$ 20,800,000	-	$ 20,800,000
California	6/30	1909	73,000,000	73,000,000	5,725,000	67,275,000	-	67,275,000
Colorado	11/30	1920	11,000.000	11,000.000	1,600,000	9,400,000	$ 235,348	9,164,652
Delaware	12/31	1917	10,237,000	9,780,000	-	9,780,000	1,146,050	8,633,950
Idaho	12/31	1911	3,623,500	(2) 3,787,000	367,000	3,420,000	738,000	2,682,000
Illinois	6/30	1919	160,000,000	89,000,000	2,000,000	87,000,000	-	87,000,000
Louisiana	12/31	1918	2,700,000	700,000	172,000	528,000	-	528,000
Maine	6/30	1913	16,823,000	13,260,500	1,280,000	11,980,500	-	11,980,500
Maryland	9/30	1908	35,380,000	35,257,000	12,047,000	23,210,000	6,263,977	16,946,023
Massachusetts	11/30	1894	16,250,000	13,767,000	8,408,000	5,359,000	3,112,607	2,246,393
Michigan	6/30	1919	50,000,000	(2) 54,419,000	4,419,000	50,000,000	7,539,878	42,460,122
Missouri	12/31	1920	60,000,000	55,000,000	7,000,000	48,000,000	2,159,667	45,840,333
Nevada	11/30	1919	1,000,000	900,000	400,000	500,000	-	500,000
New Hampshire	6/30	1909	1,000,000	750,000	750,000	-	-	-
New Jersey	6/30	1920	76,000,000	55,000,000	-	55,000,000	5,425,260	49,574,740
New Mexico	6/30	1912	2,500,000	2,500,000	180,000	2,320,000	-	2,320,000
New York	6/30	1906	100,000,000	100,000,000	2,000,000	98,000,000	32,697,980	65,302,020
North Carolina	6/30	1921	85,000,000	69,999,600	-	69,999,600	2,645,259	67,354,341
Oregon	9/30	1917	39,200,000	41,700,000	5,022,250	36,677,750	-	36,677,750
Pennsylvania	12/31	1919	100,000,000	100,000,000	2,112,000	97,888,000	5,531,627	92,356,373
Rhode Island	11/30	1906	3,100,000	3,100,000	37,000	3,063,000	912,723	2,150,277
South Dakota	6/30	1919	6,000,000	6,000,000	650,000	5,350,000	1,831,930	3,518,070
Utah	6/30	1911	7,260,000	7,260,000	-	7,260,000	1,879,000	5,381,000
West Virginia	6/30	1920	50,000,000	47,000,000	-	47,000,000	6,150,000	40,850,000
Wyoming	9/30	1919	4,600,000	4,600,000	2,710,000	1,890,000	12,122	1,877,878
Totals (25 States)		1894	$939,673,500	$ 820,780,100	$59,079,250	$761,700,850	$78,281,428	$ 683,419,422

(1) Only highway and bridge bonds issued by State included (2) Refund bonds included.

YADKIN RIVER BRIDGE TEST NOW IN PROGRESS

Contributed by E. F. Kelley, Chief of Division of Tests

Preliminary studies of the effect of temperature variations on the arch ring of the bridge over the Yadkin River between Albemarle and Mt. Gilead, N. C., are now in progress. The measurements recently begun constitute the first of a series of tests which will be made on the bridge, a Federal-aid structure, during the coming summer and autumn. The bridge which will be submerged early next year by back water from a dam now under construction is being tested under the joint auspices of the Bureau and the North Carolina State Highway Commission with the aid of an advisory committee of distinguished engineers.

The temperature of the concrete is being determined at various depths in the arch ring by means of thermometers inserted in holes drilled in the arch and previously filled with cup grease. Simultaneously with the temperature readings, measurements of the deflection of the crown of the arch are made from the datum afforded by a taut piano wire. The wire is fixed at one end and at the other, after passing over a pulley, it suspends a weight which maintains a uniform tension. The preliminary temperature studies are being made for the purpose of correcting for temperature the results obtained in the subsequent loading tests.

Representatives of the advisory committee inspected the bridge on May 15 and 16 and agreed upon a program of test procedure. The loading is to be accomplished by tanks filled with water and so constructed as to be moved readily to strategic positions. The tanks will be used for determining the stress distribution. Then if time and sufficient funds are available impact tests will be made with the aid of heavy trucks. Following this an attempt will be made to load the bridge to destruction with water tanks.

The loading measurements will include the deformations of the concrete, the deflections and change in curvature of the arch ribs and the movements of the piers. Preparations for the loading measurements are being made as rapidly as possible. To permit closing of the bridge prior to the completion of the replacing structure, a ferry will be operated across the river in the interim.

Exact dimension measurements of the existing bridge are now being taken and an analysis of the structure will be made, by the Beggs deformeter method, using a model constructed in accordance with these measurements, in order to determine the relation between the actual behavior of the structure under load and the behavior as determined by the analysis.

The names of the representatives of the various organizations constituting the advisory committee on the investigation follow:

Organization	Representative
University of North Carolina	Dean G. M. Braune, School of Engineering, University of North Carolina, Chapel Hill, N. C.
North Carolina State College	Dean W. C. Riddick, North Carolina State College, State College Station, N. C.
American Association of State Highway Officials	Searcy B. Slack, Bridge Engineer, State Highway Department, East Point, Georgia.
American Society of Civil Engineers	Prof. Clyde T. Morris, Department of Engineering, Ohio State University, Columbus, Ohio.
American Railway Engineering Association	J. B. Hunley, Engineer of Structures, C.C.C. & St. L. Ry. Co., Cincinnati, Ohio.
American Concrete Institute	A. B. Cohen, Consulting Engineer, 1 Madison Avenue, New York City.
Highway Research Board	A. T. Goldbeck, Director, Engineering Research, National Crushed Stone Assn., 651 Earle Building, Washington, D. C.
U. S. Bureau of Standards	D. E. Parsons, Associate Engineer, Bureau of Standards, Washington, D. C.
American Society for Testing Materials	F. E. Schmitt, Engineering News-Record, Tenth Ave. & 36th St., New York City.

Organization	Representative
U. S. Bureau of Public Roads	E. F. Kelley, Chief, Division of Tests.
	O. L. Grover, Bridge Engineer.
	Dr. H. M. Westergaard, Special Analyst, 806 South Lincoln Avenue, Urbana, Illinois.
	L. W. Teller, Engineer of Tests.
North Carolina State Highway Commission	L. R. Ames, State Highway Engineer, Raleigh, N. C.
	Wm. L. Craven, Bridge Engineer, State Highway Commission, Raleigh, N. C.
	M. M. Trumbull, Assistant Bridge Engineer, State Highway Commission, Raleigh, N. C.
	R. T. Giles, Engineer of Tests, State Highway Commission, Raleigh, N. C.

Geo. W. Davis, assistant engineer of tests is making the field measurements and observations for the Bureau.

NEW RESEARCH PROJECTS APPROVED

New research projects approved by the research committee and the Chief of Bureau will hereafter be published in the News Letter. These statements will serve as a record of the researches in progress. A description of the new projects of interest to highway engineers, which have been approved since the creation of the research committee last December, follows:

Title: Motor Truck Impact as Influenced by Road Type.

Approved: April 30, 1927

Leader: J. A. Buchanan.

Object: To determine the so-called cushioning properties of the various road types under controlled conditions of motor truck impact.

Procedure: Briefly, the procedure would be to select a number of road types such as plain concrete, sheet asphalt on concrete base, bituminous concrete on concrete base, and penetration macadam in the vicinity of Arlington or in the District of Columbia, and on these sections to produce motor truck impact having the conditions of load, tire equipment and height of drop constant, and by a comparison of the magnitudes of the impact forces produced to determine whether or not these various types have different properties in this respect.

To produce these impacts two methods suggest themselves as feasible. First, by using the impact machine already available it would be possible to produce at any given point impacts which were comparable on each type of road by measuring the height of drop and impact reaction. This impact machine could be very easily equipped with a set of trailer wheels which would enable it to be transported from one location to another very quickly. Power for operating the impact testing machine could be supplied by a gasoline engine mounted on the truck which would be used to tow the impact machine.

Second, it would be possible to take one of the test trucks which have been used in the impact tests so far and, by causing this truck to pass over artificial obstructions such as the inclined planes already used, at a known speed, comparable impacts would be produced on the different types of road surface. It would be possible to control the impacts

more closely with the impact machine and, therefore, the tests with the motor truck might be considered as supplementary.

It would be preferable to make the first tests with a worn solid tire and a rather heavy truck as representing the worst condition, and if the differences in the impact reactions found on the various road types warrant it, then the program could be amplified to include other tire and weight conditions.

On the bituminous types it would be necessary to make a number of tests at times when the temperature of the bituminous material covered as wide a range as possible, as undoubtedly the temperature would materially affect the behavior of this material.

The procedure outlined would require no new equipment as the trucks, tires, testing machine, trailer, gasoline engine and measuring instruments are all available.

Cooperation: None. The cooperation of the highway departments of the State of Virginia and of the District of Columbia would be necessary to the extent of granting permission to use highways in their jurisdiction for the purpose of these tests.

Location: The Arlington Experimental Farm and nearby highways where suitable road surfaces may be found.

Legal authority: Section 21 of the Federal Highway Act, approved November 9, 1921, (42 Stat. 212) for administering provisions of Act and for carrying on necessary highway research and investigational studies. Appropriation designation: "Cooperative Construction of Rural Post Roads, Administrative Expenses."

Proposed expenditure (based on an estimated test period of 2 months and including all salaries, materials, supplies, operation of equipment and contingencies): $2500.00

History: The only data which are available on this subject are the results of the impact tests on pavement slabs conducted several years ago by this Bureau. These tests indicated that there was little, if any, cushioning value of a bituminous top at temperatures of 90°F. or less. These data have been questioned somewhat and it would seem very desirable to obtain further information on this important matter.

DATE EFFECTIVE: IT IS PROPOSED TO CONDUCT THIS RESEARCH DURING THE SUMMER MONTHS, AND AS THE TESTS WILL BE CONTROLLED MORE OR LESS BY TEMPERATURE CONDITIONS IT IS BELIEVED THAT THIS PROGRAM CAN BE CARRIED OUT IN CONJUNCTION WITH THE OTHER IMPACT WORK. THE MOBILITY OF THE EQUIPMENT WILL MAKE IT VERY EASY TO WORK FROM THE ARLINGTON FARM AS A BASE.

TITLE: FOUNDATION PILE-HEAD BOND AND ANCHORAGE TESTS.

APPROVED: MARCH 15, 1927

LEADERS: GEO. W. DAVIS AND E. R. BLOOMQUIST.

OBJECTS: TO DETERMINE THE BOND STRESS DEVELOPED BETWEEN THE HEADS OF FOUNDATION PILES AND CONCRETE-FOUNDATION SEALS AND TO INVESTIGATE METHODS OF ANCHORING REINFORCEMENT BARS TO PILE HEADS.

PROCEDURE: SIX SERIES OF TESTS ARE TO BE MADE AND IN EACH SERIES SEVERAL TEST SPECIMENS WILL BE INCLUDED. IN ALL SPECIMENS SHORT SECTIONS OF TIMBER PILES WILL BE USED. THE PILES WILL BE THOROUGHLY SOAKED IN WATER AND WILL BE ENCASED WHILE WET IN 1:2:4 CONCRETE JACKETS OR BLOCKS WHICH WILL SIMULATE FOUNDATION-SEAL CONCRETE. AFTER THE CONCRETE HAS SET SUFFICIENTLY THE ENTIRE SPECIMENS WILL BE IMMERSED IN WATER AND WILL REMAIN IN WATER UNTIL TESTED. THE BOND TESTS WILL BE CONDUCTED AT VARIOUS AGES BEGINNING AT 7 DAYS, IF POSSIBLE. THE ANCHORAGE TESTS WILL BE MADE AT THE AGE OF 21 DAYS.

BOND TESTS WILL BE MADE BY PULLING THE PILE HEADS FROM THE CONCRETE BLOCKS BY MEANS OF AN HYDRAULIC JACK. THE ANCHORAGE OF REINFORCEMENT WILL BE DETERMINED BY PULLING THE STEEL FROM THE PILE SECTIONS IN A 200,000-POUND TESTING MACHINE.

THE DETAILS OF THE SIX SERIES OF PROPOSED TESTS ARE AS FOLLOWS:

SERIES 1. BOND.

TWELVE PILE HEADS TURNED TO A CONSTANT DIAMETER AND 4 ROUGH PILE HEADS OF MINIMUM BATTER, PEELED AND ROUGHLY TRIMMED, WILL BE ENCASED IN CONCRETE BLOCKS. BOND STRESS WILL BE DETERMINED

BY PULLING THE PILES FROM THE BLOCKS.

SERIES 2. BOND.

SIX PILE HEADS WILL BE TURNED TO CONSTANT DIAMETER AND, AFTER BEING BANDED WITH A STEEL RING TO PREVENT SPLITTING, THE HEADS WILL BE EXPANDED IN TWO DIRECTIONS AT RIGHT ANGLES TO EACH OTHER BY DRIVING OAK WEDGES 2 INCHES WIDE AND 12 INCHES LONG. THE SPECIMENS WILL THEN BE ENCASED IN CONCRETE BLOCKS AND BOND STRESS DETERMINED BY PULLING THE PILES FROM THE BLOCKS.

SERIES 3. BOND.

THREE PILE HEADS WILL BE TURNED TO CONSTANT DIAMETER AND STUDDED WITH LARGE-SIZE SPIKES WHICH WILL BE LEFT WITH A PROJECTION OF ABOUT 2 INCHES. THE SPECIMENS WILL THEN BE ENCASED IN CONCRETE BLOCKS AND BOND STRESS DETERMINED BY PULLING THE PILES FROM THE BLOCKS.

SERIES 4. ANCHORAGE OF REINFORCEMENT.

FOUR PILE HEADS WILL BE TURNED TO CONSTANT DIAMETER AND ENCASED IN REINFORCED CONCRETE JACKETS. IN EACH PILE HEAD A $1\frac{1}{2}$-INCH ROUND BAR, ROUGHENED BY HACKING WITH A COLD CUTTER, WILL BE DRIVEN TO A DEPTH OF ABOUT 27 INCHES IN A HOLE OF 1-3/8-INCH DIAMETER. THE VALUE OF THIS ANCHORAGE WILL BE DETERMINED BY PULLING THE BAR FROM THE PILE HEAD.

SERIES 5. ANCHORAGE OF REINFORCEMENT.

FOUR PILE HEADS WILL BE TURNED TO CONSTANT DIAMETER AND ENCASED IN REINFORCED CONCRETE JACKETS. IN EACH PILE HEAD A $1\frac{1}{2}$-INCH ROUND STEEL FOX-BOLT WILL BE DRIVEN TO A DEPTH OF ABOUT 27 INCHES IN A HOLE OF 1-3/8-INCH DIAMETER. THE END OF THE BOLT WILL BE SPREAD IN THE BOTTOM OF THE HOLE BY MEANS OF A STEEL WEDGE ABOUT 1 INCH THICK AND 4 INCHES LONG. THE VALUE OF THE ANCHORAGE WILL BE DETERMINED BY PULLING THE BAR FROM THE PILE HEAD.

SERIES 6. ANCHORAGE OF REINFORCEMENT.

FOUR PILE HEADS TURNED TO CONSTANT DIAMETER WILL BE EXPANDED AT ONE END BY MEANS OF OAK WEDGES AND A HEAVY STEEL COLLAR WILL BE CLAMPED AROUND THE PILE JUST BELOW THE POINT OF EXPANSION. REINFORCEMENT BARS WILL BE HOOKED TO THIS COLLAR AND THE WHOLE WILL BE ENCASED IN A REINFORCED CONCRETE JACKET. THE VALUE OF THE ANCHORAGE WILL BE DETERMINED BY PULLING OUT THE REINFORCEMENT BARS.

COOPERATION: NONE.

LOCATION: ARLINGTON EXPERIMENTAL FARM.

LEGAL AUTHORITY: SECTION 21 OF THE FEDERAL HIGHWAY ACT, APPROVED NOVEMBER 9, 1921, (42 STAT. 212) FOR ADMINISTERING PROVISION OF ACT AND FOR CARRYING ON NECESSARY HIGHWAY RESEARCH AND INVESTIGATIONAL STUDIES. APPROPRIATION DESIGNATION: "COOPERATIVE CONSTRUCTION OF RURAL POST ROADS, ADMINISTRATIVE EXPENSES."

PROPOSED EXPENDITURE: ABOUT $1000.

HISTORY: THE INVESTIGATION IS REQUESTED BY THE BRIDGE DIVISION OF THE BUREAU. THE BOND STRENGTH OF TIMBER PILE HEADS ENCASED IN CONCRETE IS OF IMPORTANCE IN BRIDGE CONSTRUCTION IN CONNECTION WITH THE DESIGN OF CONCRETE-FOUNDATION SEALS FOR COFFER-DAMS, SINCE THESE SEALS MAY BE MATERIALLY REDUCED IN DEPTH IF ADVANTAGE IS TAKEN OF THE BOND DEVELOPED BY THE PILE HEADS IN THOSE CASES WHERE PILES ARE USED. LITTLE IS KNOWN REGARDING THE VALUE OF THIS BOND. APPARENTLY THE ONLY INFORMATION AVAILABLE IS CONTAINED IN A PAPER "BOND STRENGTH OF WOOD PILES IN CONCRETE" IN THE TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS FOR 1923, VOLUME LXXXVI, PAGE 268. THIS PAPER REPORTS SOME TESTS MADE FOR THE MILWAUKEE SEWERAGE COMMISSION BUT ON ACCOUNT OF THE LIMITED EXTENT OF THE INVESTIGATIONS THE RESULTS CAN SCARCELY BE ACCEPTED AS CONCLUSIVE AND SHOULD BE CORROBORATED BY FURTHER TESTS.

THE EFFECTIVE ANCHORAGE OF REINFORCEMENT IS OF IMPORTANCE IN CONNECTION WITH THE DESIGN OF SUBSTRUCTURES OF BRIDGES WHICH WILL BE REQUIRED TO RESIST THE ACTION OF HURRICANES. FEDERAL-AID BRIDGES WHICH MAY BE EXPOSED TO HURRICANES ARE BEING AND WILL BE BUILT ALONG THE SOUTHERN ATLANTIC AND GULF COASTS. THE POSSIBLE EFFECTIVENESS OF THE TYPES OF ANCHORAGES PROPOSED FOR THIS INVESTIGATION MAY BE OPEN TO SOME QUESTION BUT IT IS FELT THAT THESE TYPES WHICH HAVE BEEN SUGGESTED SHOULD BE INVESTIGATED TO THE LIMITED EXTENT OUTLINED.

DATE EFFECTIVE: APRIL 1, 1927.

TITLE: DETERMINATION OF DRAINAGE INDEX FOR SOILS.

APPROVED: MARCH 15, 1927.

LEADER: F. E. STAEBNER.

OBJECTS: 1. TO DETERMINE THE RELATION OF SOIL STRUCTURE TO DRAINAGE WITH A VIEW TO DEVELOPING DRAINAGE COEFFICIENTS OR DRAINAGE INDICES OF SOILS THAT WILL MAKE IT POSSIBLE, BY SOME SIMPLE TESTS, TO DETERMINE THE MOST EFFECTIVE DEPTH AND SPACING OF DRAINS FOR VARIOUS TYPES OF SOILS.

2. TO DETERMINE THE ECONOMIC LIMIT OF DEPTH AND SPACING OF DRAINS FOR SOILS OF VARIOUS CHARACTERISTICS.

AT THE PRESENT TIME THERE IS NO METHOD OF DETERMINING THE MOST EFFECTIVE DEPTH AND SPACING FOR DRAINS AND THE INSTALLATION OF SUCH IMPROVEMENTS IS USUALLY BASED UPON THE EXPERIENCE AND JUDGMENT OF THE ENGINEER DESIGNING THEM. AS THERE IS A WIDE VARIATION IN THE PERCOLATION THROUGH VARIOUS SOILS HAVING THE SAME PHYSICAL APPEARANCE, DRAINS PLACED AT THE SAME DEPTH AND DISTANCE APART IN WHAT APPEAR TO BE SIMILAR SOILS MAY OPERATE SUCCESSFULLY IN ONE CASE AND UNSUCCESSFULLY IN ANOTHER. IT IS WITH A VIEW TO DEVELOPING SOME METHOD THAT WILL ENABLE THE ENGINEER TO DETERMINE IN ADVANCE THE PROPER DEPTH AND SPACING FOR DRAINS THAT THIS PROJECT IS UNDERTAKEN.

PROCEDURE: IT IS BELIEVED THAT THERE IS A DEFINITE RELATION BETWEEN THE PERMEABILITY FACTOR OF A SOIL AND ITS SUSCEPTIBILITY TO DRAINAGE, BUT THERE IS SOME QUESTION AS TO WHETHER SUCH PERMEABILITY FACTOR IS CONSTANT OR UNIFORM. THE FIRST STEP WILL BE TO DETERMINE WHETHER OR NOT THE PERMEABILITY OF A SOIL IS CONSTANT. THIS WILL BE ACCOMPLISHED BY SECURING SOIL SAMPLES WITH UNDISTURBED STRUCTURE AND, IN THE LABORATORY UNDER CONTROLLED CONDITIONS OF WATER SUPPLY, DETERMINING THE PERMEABILITY FACTORS FOR SUCH SAMPLES.

IT IS REALIZED THAT THE DETERMINATION OF THE PERMEABILITY FACTOR IS A PAINSTAKING, COMPLICATED AND EXPENSIVE PROCEDURE AND IT IS THEREFORE PLANNED AT THE SAME TIME TO GATHER ADDITIONAL SAMPLES OF THE SAME SOILS IN THE USUAL METHOD (WITH AN AUGER), AND TO SUBJECT SUCH ADDITIONAL SAMPLES TO COMPLETE LABORATORY ANALYSIS WITH THE OBJECT OF FINDING SOME EASILY-TESTED PROPERTY THAT VARIES IN SUBSTANTIALLY A DIRECT RELATION WITH THE PERMEABILITY FACTOR. IF SOME SUCH PROPERTY IS FOUND, A DRAINAGE INDEX FOR SOILS CAN BE DEVELOPED THAT CAN BE DETERMINED BY SIMPLE TESTS.

The laboratory work will be correlated with extensive examinations of drained soils in the field to determine the relation between the permeability factors or drainage indices as developed, and economical field drainage.

Cooperation: None.

Location: Washington, D. C.

Legal authority: Appropriation, Bureau of Public Roads, Agricultural Engineering.

Proposed expenditure: Anticipated expenditures for fiscal year 1927, $1,775.00

History: An extensive investigation fails to disclose any attempt among research workers to ascertain the relation of the percolation of water through samples with undisturbed structure - as determined by laboratory tests - to the problem of practical field drainage. Whitney made a limited investigation of the percolation through small samples of undisturbed soil and reported that percolation diminished rapidly with successive additions of water and finally ceased entirely. No attempt was made, however, to correlate these results with conditions where water percolates through soils for an indefinite period, as in field drainage.

A number of investigators have conducted experiments with disturbed soils which have been dried, powdered, and sifted and then packed into tubes for percolation tests. The results secured have varied widely due, it is believed, to the fact that the experiments were conducted with disturbed soil structures. C. Hugues states that he found permeability did not diminish as long as the soil was covered with water. Bouyoucos found that the rate of percolation varied with temperature.

A number of German investigators have presented suggestions for basing drainage indices for soil on hygroscopicity; on the content of clay less than .002 mm; on elutriable parts less than 0.01 mm; and on the specific surface of soil particles; but the results secured have varied widely and have not been generally accepted. The range of spacing for drains recommended by various men have more or less agreed but result in a much closer spacing than is generally practiced in this country.

Date effective: April 1, 1927.

NEW MOTION PICTURE IN PREPARATION

A new motion picture entitled "Wheels of Progress" is now being prepared for the Bureau by the Office of Motion Pictures of the Department. The new film contrasts transportation conditions of 30 years ago with modern methods and shows various uses of present-day motor vehicles.

The film will be given an initial public showing in June at the International Chamber of Commerce meeting in Stockholm, Sweden. Shortly, thereafter, copies will be available for distribution in this country in accordance with the regular departmental procedure.

THE NEWS LETTER
OF THE
BUREAU OF PUBLIC ROADS

VOL. 2 NO. 7 MAY, 1927 A. C. ROSE, EDITOR

CORRECTION

In the memorial on page 37 of the May, 1927, News Letter, Mr. Wonders was referred to inadvertently as District Engineer of District 8 instead of District 5 — the correct number.

James Crew Wonders

James Crew Wonders, district engineer of district 8 of the Bureau, with headquarters at Omaha, died at 7:30 o'clock on Monday evening, June 6, as a result of a prolonged illness due to pernicious anaemia. He is survived by his wife, Belle Spellman Wonders, and three sons, Samuel D. Wonders, of Springfield, Mass., Reverend Donald Wonders, of Sandusky, O., and Fred J. Wonders of Cleveland O., all of whom were in Omaha at the time of his death. Mr. Wonders was born in Logan County, Ohio, on December 10, 1860.

On March 16 of this year Mr. Wonders, who had been in ill health for some time, was ordered to the hospital by his family physician after an examanation as a result of which his condition was diagnosed as anaemic. At that time his case was considered serious but not necessarily grave and it was believed he would recover after a period of rest and prescribed dieting.

On March 20, the telebraphic news of the death of his youngest son, Dr. Max E. Wonders, following injuries received in an automobile accident aggravated his already serious condition.

On April 9 Mr. Wonders, who had never recovered from the shock caused by the death of his son, was still in the hospital. It was expected, however, that he would improve sufficiently to be able to return to his home within a short time. This proved to be the case but on May 5 he suffered a relapse and was returned to the hospital where physicians in consultation decided on a blood transfusion at the earliest favorable opportunity. This operation was performed on the following Monday.

The blood transfusion, however, did not appreciably improve his condition. On the contrary he suffered a chill immediately afterward and in spite of the efforts of the attending physicians his condition grew steadily worse.

Mr. Wonders obtained his secondary education in the public schools at Zanesville, O., and the National Normal School at Lebanon, O. His collegiate education was obtained as a special engineer student at the Ohio State University from which he was graduated in 1883.

He began his first engineering engagement as deputy county engineer of Logan County, O., in 1883. In 1884 he was promoted to his first executive position as city engineer of Bellefontaine, O., his home town, a position which he held until 1901 when he became

COUNTY ENGINEER OF LOGAN COUNTY. HE GAINED PROMINENCE AMONG THE ENGINEERS OF THE STATE DURING THE TWO PERIODS THAT HE HELD THE OFFICE OF COUNTY ENGINEER FROM 1888 TO 1894 AND FROM 1900 TO 1906. BESIDES HIS REGULAR POSITIONS HE CARRIED ON A GENERAL ENGINEERING PRACTICE FROM 1884 TO 1906.

THE THOROUGHNESS OF HIS WORK AS COUNTY ENGINEER ATTRACTED THE ATTENTION OF THE OHIO CANAL COMMISSION AND THE STATE BOARD OF PUBLIC WORKS WHICH EMPLOYED HIM ON SPECIAL ENGINEERING ASSIGNMENTS FROM 1892 TO 1906. AT THE EXPIRATION OF THIS PERIOD HE GAVE UP COUNTY AND GENERAL ENGINEERING PRACTICE AND ACCEPTED THE APPOINTMENT AS ENGINEER IN CHARGE OF THE RECONSTRUCTION OF THE MIAMI AND ERIE CANAL FROM CINCINNATI TO TOLEDO. HIS SUCCESS IN THIS UNDERTAKING AND HIS ROAD-BUILDING EXPERIENCE SECURED FOR HIM THE APPOINTMENT OF STATE HIGHWAY COMMISSIONER IN 1908. THIS POSITION HE HELD UNTIL 1911 WHEN HE ENTERED THE SERVICE OF THE BUREAU AS A ROAD EXPERT. HE WAS PROMOTED RAPIDLY TO SENIOR HIGHWAY ENGINEER IN MAY 1912 AND LATER TO DISTRICT ENGINEER IN DECEMBER 1916. THIS POSITION HE HAS HELD FOR 11 YEARS.

IT WAS UNDER MR. WONDERS DIRECTION THAT THE FIRST PIECE OF CONCRETE PAVEMENT IN AMERICA WAS DESIGNED AND CONSTRUCTED. THIS WAS BUILT IN BELLEFONTAINE IN 1893 AROUND THE BLOCK ADJACENT TO THE COUNTY COURTHOUSE, AN AREA WHICH WAS UNDER THE JURISDICTION OF THE COUNTY AUTHORITIES. THIS CONCRETE, LAID IN THE FALL, WAS CURED BY MOISTENED STRAW AND MR. WONDERS WORRIED CONSIDERABLY AT THE TIME FOR FEAR OF ADVERSE FROST ACTION. HIS FEARS PROVED TO BE GROUNDLESS, HOWEVER, FOR FAVORABLE WEATHER PERMITTED THE PAVEMENT TO REACH ITS FINAL SET. HE CONTINUED TO STUDY CONCRETE WHILE IT WAS BEING CONDEMNED BY OTHERS AND LAID THE FIRST CONCRETE PAVEMENT ON THE RURAL HIGHWAYS IN 1910 WHILE HE WAS IN CHARGE OF THE STATE ROAD WORK.

AS STATE HIGHWAY COMMISSIONER MR. WONDERS INTRODUCED THE COMPETITIVE SYSTEM OF AWARDING CONTRACTS IN OHIO AND LAID THE FOUNDATION FOR THE EFFICIENT ADMINISTRATION OF THE STATE HIGHWAY DEPARTMENT. AS EARLY AS 1909 HE FORESAW THE NEED OF A NATIONAL HIGHWAY SYSTEM AND EXERTED HIS INFLUENCE AS STATE HIGHWAY EXECUTIVE TOWARD THE COMPLETION OF THE MAIN STATE ROADS SUCH AS THE OLD NATIONAL PIKE.

AS AN EXECUTIVE MR. WONDERS WAS CHARACTERIZED BY HIS PATIENCE AND BY HIS JUST AND IMPARTIAL DECISIONS. OF AN EXTREMELY ANALYTICAL MIND, HE WAS ABLE TO ARRIVE AT A REASONABLE DECISION AND WAS RARELY RUFFLED OR DISTURBED. HE HAD A KIND AND LOVABLE PERSONALITY WHICH WON FOR HIM THE ESTEEM AS WELL AS THE LOYALTY OF HIS SUBORDINATES. HE WAS A RELIGIOUS MAN AND A REGULAR CHURCH ATTENDANT.

He was a member of the American Society of Civil Engineers and the Ohio Society of Engineers. His fraternal connections included the Masonic order and the Phi Kappa Psi college fraternity.